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American Insulated Wires. WE begin in this issue the publication of a series of tests which will, we think, be followed with more than ordinary interest by many of our readers. The subject of the proper insulation of wires is one that is constantly assuming greater importance, as is witnessed by the recent discussion on the subject before several electrical organizations, and is one in which the insurance interests take a lively concern. Although, for obvious reasons, the names of the various makers are not given, the investigation in itself is of sufficient value to warrant very careful study; and the results obtained in the long-time exposure of wires under varying conditions, which will follow in our next issue, are of the greatest importance as demonstrating the continued safety of electric lighting service in buildings properly wired.

Light Without Heat. THUS far the problem of obtaining light without the wasteful accompaniment of heat, though prominently discussed during the past few months, has not, it appears, advanced beyond the speculative stage. But, if we are to give credence to a correspondent, whose communication appears in another column, the solution of the problem is accomplished, and, strange as it may seem, in a manner which was recently suggested by Prof. C. W. Brackett, in his address before the New York Electric Club, which we printed at the time. Mr. A. B. Worth, in order to place himself on record, claims to have utilized, some years ago, the method of polarized light, suggested by Prof. Brackett, and his later results are such as to warrant the assertion that, if practicable, he will find that he has not wasted his time. It is, indeed, difficult to foresee the ultimate effect upon our present mode of life of a source of light entirely devoid of heat, and our readers will no doubt await with interest the publication of more complete details of Mr. Worth's methods.

Electric Railways. A YEAR ago there were barely a score of electric roads in this country and about another score were projected. To-day there are over fifty roads, and nearly seventy more are building or under contract. There is still plenty of room for improvement in the methods adopted, but the roads *work* and are certainly good enough to advertise the method as a success. We may well apply to this the language that Prof. Bryce in his recent noble work on the "American Commonwealth" uses about some of our political conditions: "The Americans surpass all other nations in their power of making the best of bad conditions, getting the largest results out of scanty materials or rough methods. Many things in that country work better than they ought to work or could work in any other country." After all there is no better way of reaching perfection than through experiment and failure, and every one of the successes in electric railroading in this country has been won by the very finest qualities of grit, self help and shrewdness. Our motor engineers know something now about electric roads and have laid the foundations of an enormous industry by their genius and perseverance.

Ring Armatures. WHILE a tolerably good theory of the dynamo exists at present, upon which machines may be designed without recourse to much previous experimenting, the fact remains that the exigencies of practical construction and the flexibility of the problem to be solved introduce novel factors with which the designers of dynamos often have to deal. A good illustration of this is presented in the calculation of the proportions of the Gramme ring in a machine of a given output. With a given mass of metal a variety of proportions may evidently be adopted, more particularly with respect to the armature. The problem as it presents itself in its simplest form is well discussed in the article by Mr. R. S. Dobbie, which will be found on another page, and in which more particularly the ratio between the radial depth and the axial length of the Gramme ring is treated of, and their relation to the length of a convolution, area of pole-pieces, etc. The author brings out several anomalous relations between these various quantities, which makes the choice of the best proportions of some consideration. At all times the question of constructional facility must be taken into account, with the unfortunate consequence that in this, as in many other cases, the most favorable proportions assigned by theory cannot be carried out practically.

Synchronous Telegraphy. IT was recognized some time ago that if perfect synchronism could be maintained between two moving devices placed at a distance from each other, their motion would afford a means of multiplying the capacity of a telegraph wire many times. The problem of obtaining such synchronism has been attempted in a variety of ways, and one of these systems, that of Delany and Callahan, has gone into quite extensive use in England. In this system, as is well-known, the synchronism depends upon the equal rate of vibration of two reeds or tuning forks placed at opposite ends of the wire. With the advent of the alternating current motor, however, and the repeated reference to the fact that these machines would run, and, in fact, of necessity must run, in synchronism with the generating machine, it is not to be wondered at that the quick mind of the inventor should seize upon this fact and make it the basis of a system of synchronous telegraphy. This has has been done by Lieut. F. Jarvis Patten, U. S. A., and one of the methods devised by him is described elsewhere in this issue. The field here opened to the introduction of the alternating current motor seems hardly less promising than that opened to it for power distribution, and active experiment has even now advanced sufficiently to demonstrate the entire feasibility of such a system.

Unarmored Ocean Cables. WE publish on another page a very interesting and suggestive article by Judge Weatherbee, of Halifax, N. S., as to the conditions affecting deep ocean cables, and making the point that such cables should not be armored. Halifax is the home of the Atlantic cable laying and repairing squadron, and hence Mr. Weatherbee has had special opportunities to study this matter in its practical bearings. We must say that the argument he advances strikes us as very forcible and cogent, and the instances that he cites in support of his views are at once confirmatory and significant. It would indeed be a great change if our ocean cables hereafter were of the type he describes, with a greatly increased capacity for speed in working; and yet the change would not be greater in its way than that which the navies of the world are undergoing, in casting away their armor plates to gain speed and efficiency for the newer style of combat with torpedo boats and dynamite cruisers. It seems to us that Judge Weatherbee has made out a good case, so far as ocean cables are concerned. We note that he speaks of a section of such hemp cable laid in the harbor water, but it would perhaps be well to retain the armor as a general thing wherever there would be a liability to mechanical injury. But out in the depths of mid ocean, a plain, unarmored cable ought to be adequate to all strains, and the claim made of greater speed of working is certainly worth looking into.

RECENT TELEPHONIC INVESTIGATIONS.

Electricians have so often had their preconceived ideas rudely shaken by the results of rigid experiment that the time for dogged persistence in past errors has almost passed, and new truths are assimilated with ease. Among such cherished ideas is the alleged infinitesimal strength of the ordinary telephonic current, a conception arising, no doubt, from the alternating nature of the telephonic current and the difficulty of constructing suitable instruments for its measurement. In referring to this subject, in a lecture before the Boston Society of Arts on work done at the Massachusetts Institute of Technology, Prof. Ch. R. Cross drew attention to the faulty construction of instruments intended for such investigations. Such instruments failed largely through the use of metal in close inductive proximity to the coil carrying the telephonic current to be measured, which gave rise to induced currents that weakened the original. Having removed this source of error by the construction of a galvanometer without metal, Prof. Cross finds that the average telephone current is far greater than is popularly supposed. The average current strength was not far from $\frac{5}{10}$ of a milli-ampère, while an Edison lamp takes $\frac{1}{2}$ ampère, or only 1,000 times as much; and in the loud speaking telephone it was 20 milli-ampères, an amount sufficient to give one a good shock. Lastly, it was found possible to transmit speech distinctly by a current which could not be detected by the most sensitive instruments. These currents, from $\frac{5}{10}$ to 20 milli-ampères, were produced by speaking or sounding a loud note from an organ pipe into the transmitter. These results were also confirmed by experiments on actual working lines. Much more interesting, however, were the experiments on the New York long-distance line for the purpose of estimating the losses. For this work granulated carbon Hunning transmitters were used. In talking to New York practically all the current passing into the line traversed the instrument and was measured. The operator in New York then talked over the line, and the current, less the loss, was found to be $\frac{1}{100}$ to $\frac{8}{100}$ milli-ampère, while, when entering the instrument before passing over the line it was 10 to 20 milli-ampères, giving a loss of over 99 per cent. The actual working current was, therefore, exceeding small—in fact, absolutely much smaller than on the city lines. There should have been no unusual losses as the day was perfectly clear. That the service over the long distance lines should be so good is evidently due to the use of a metallic circuit of low resistance and retardation, and the sounds were clearer and more easily understood than on the city lines. The value of the current as determined by the material and shape of electrodes was also studied, and carbon, platinum, iron and copper employed in various combinations. Carbon with carbon gave a large range of variation, platinum on platinum a greater range, which fell off suddenly. With iron the curve was low. In altering the electrodes a curious point was noticed, for it makes considerable difference which is the anvil electrode. It was found that the anvil is the governing electrode, for, with carbon as the anvil, the curve is like that of carbon for both, although the other may be of iron.

NEW BOOKS.

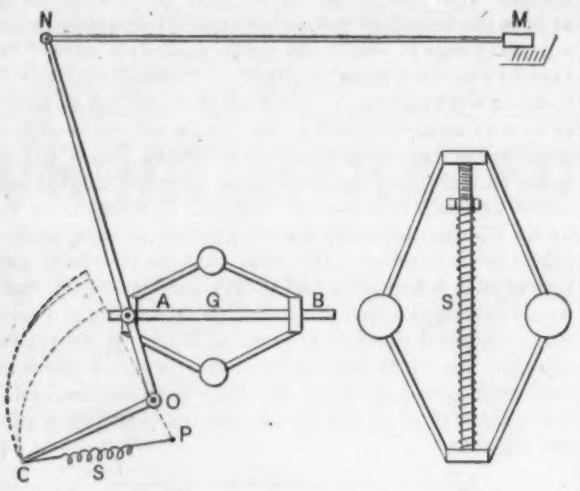
PROCEEDINGS OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION, New York meeting, August, 1888. Vol. V. *Modern Light and Heat.* Boston, Mass. 364 pages.

This is at once a valuable and handsome volume of transactions. The work done at the New York August meeting was important, and it is satisfactory to get it so soon in its permanent official form, convenient in size and well printed in bold type. We would specially commend as a good piece of work the Index of Contents, printed at the end.

Mechanical Regulation of Electric Motors.

BY R. B. OWENS.

The two systems of electrical distribution of energy most used to-day are, first, that in which the difference of potential between the two mains is kept constant, the



FIGS. 1 AND 2.—GOVERNORS FOR MOTORS.

energy consumed varying as the current; and, second, that in which the line current is kept constant and the electromotive force between the poles of the dynamo made to vary as the work done in the circuit.

One of the first problems which presented itself was to make a motor which should run at a practically constant speed with load varying from zero to the maximum capacity of the machine. On the constant potential system the regulation is very perfectly effected by the winding of the field magnets; but on the constant current system the problem is more difficult, and can hardly yet be said to be *perfectly* solved. However, it is very generally recognized at present that *the* way to regulate a constant current motor is to strengthen and weaken the field as more or less load is thrown on, and *vice versa*. Automatic regulation has been attempted by rotating the brushes, but this causes sparking besides lowering the efficiency with a decrease of the load. The varying of the field intensity is usually effected by the sliding back and forth of a block of copper over the ends of a number of strips which are connected to the several layers of the field magnets; or, in other words, short circuiting the magnet coils, and thus weakening the fields.

The majority of devices of this sort have the defect of not giving sufficiently close regulation; that is to say, they require quite a large increase in speed of armature to produce the required short circuiting of the coils. Indeed, this is quite evident where the centrifugal force of the governor balls is opposed by a spring, as in Fig. 2. But the arrangement shown in Fig. 1 seems to offer better results. Here *M* is a block of copper which, sliding across the ends of strips from each magnet, short circuits the magnet coils. *G* is a centrifugal governor, the end *B* of which is pinned to the armature shaft, the end *A* being attached to the lever (whose fulcrum is *O*), and which actuates the slide *M*.

S is a spring, one end of which is attached to a point *P*; the other end is attached to the end *C* of the lever *N O C*. When the armature revolves the governor balls tend to fly apart, causing *M* to move forward over the strips; this tendency is opposed by the spring *S*.

It will be seen that by this arrangement, as the end of the lever *C* traces an arc of a circle, whose centre is *O*, for equal portions of the arc so traced the elongation of the spring becomes less and less. Indeed, were *C* carried beyond the line joining *P* and *O*, the spring would act with the governor in moving *M* forward. Hence, if the parts are so proportioned that as *M* moves over the strips *C* traces a short arc, one end of which ends on the line joining *P* and *O*, we may obtain quite sensitive regulation. For, as shown, the motion of *M* is not proportional to the elongation of the spring. The arrangement shown in Fig. 2, however, cannot be very sensitive from the fact that the motion of the slider must be directly proportional to the compression of the spring.

A Substitute for the Compass.

The London *Electrician* prints a singular rumor to the effect that the use of the compass is about to be altogether superseded. A method is said to have been discovered by which the true North may at any moment be ascertained by means of a device which is wholly independent of magnetic action. The reading is, however, obtained by electrical means, and it is said that a well-known Berlin firm of electricians has secured the patents. The informant also surmises that gyroscopic action is involved.

Patten's Multiplex Telegraph System.

We are able to give in this issue a description of the general features of a new system of multiplex telegraphy invented by Lieut. F. Jarvis Patten, U. S. Army. The system is of the synchronous multiplex type and has a number of important variations both in the synchronizing devices and in the method of transmission that will be described in detail at a later day.

The accompanying diagram shows the principal circuits and connections at a sending and receiving station, as arranged in one of the systems used by Lieut. Patten. *X* is a sending and *Y* is a receiving station, the equipments of which are nearly identical in arrangement, differing only in the connections of the synchronizing apparatus, which consists of the following operative parts:

At the sending station *X* is an ordinary direct current electric motor M^1 driven by an independent battery $M\,B^1$, provided with an armature of the ordinary Siemens H type, $A^1\,A^1$. This armature is connected through the commutator $c^1\,c^2$ and brushes $b+$ and $b-$ to the motor battery $M\,B^1$. The armature coil A^1, instead of being a simple closed coil, is broken at its middle point, and the two terminals thus formed are secured to the two insulated contact rings r^1 and r^1, upon which the brushes b^1 and b^1 bear. To these brushes an external loop $l\,l$, including the coils of a polarized relay, P^1 is connected. The armature circuit $A^1\,A^1$ is therefore closed through an independent external loop $l\,l$, forming an independent part of the armature circuit.

From the operation of such machines it follows that an alternating current reversed at each half revolution of the armature circulates in the loop $l\,l$, as a result of the action of the two-part commutator $c^1\,c^2$. These alternating currents cause the tongue or armature v^1 of the polarized relay P^1 to vibrate between the contact stops E^1 and E^3, at each reversal of current in the motor armature A^1 and loop $l\,l$. The fixed end of this armature v^1 is attached to the main line $M\,L$, extending from the station *X* to the station *Y*.

The contact stops E^1 and E^3, against which the vibrating tongue v^1 strikes at each reversal of current, are connected to the opposite poles of the line battery $L^1\,B^1$, of the motor M^1 at station *X*. The relay at the distant station *Y* has the fixed end of its vibrating tongue v^2 connected in the field circuits of the motor M^2 at *Y*, the other terminal of the field coils being connected to the middle point of the split battery $L^2\,B^2$, the terminal poles of which are connected to the contact stops of the relay P^2.

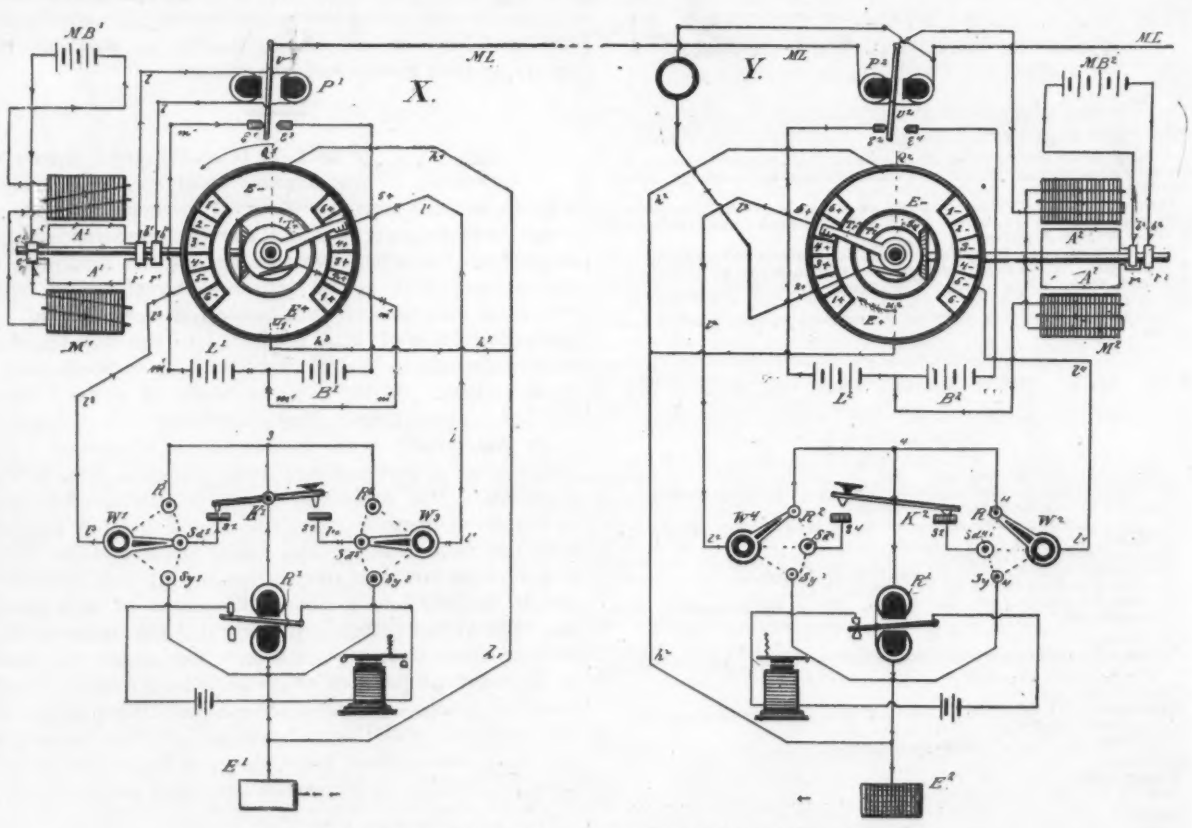
From these connections it follows that as the tongue v^2 of the relay P^2 at the station *Y* vibrates to and fro it will send alternate currents through the field coils of the motor M^2 at station *Y*, and its field magnetism will be reversed at each vibration of the tongue of the polarized relay P^2. Now the armature $A^2\,A^2$ of this motor M^2 is supplied with a continuous direct current from the independent battery $M\,B^2$ through the insulated contact rings $r^2\,r^2$, to which the armature terminals are connected. Having thus a direct current in the armature and an alternating field, this motor will revolve and its armature will turn precisely one-half a revolution at each reversal of the field current and magnetism of the field; but as this current and the induced magnetism are reversed by the polarized relay P^2 while moving in unison with the relay at station *X*, which latter beats the half revolutions of the armature $A^1\,A^1$ of the motor at that station, it follows that the two machines M^1 at *X* and M^2 at *Y* must revolve in unison with each other, the half revolutions of the armature in one machine corresponding precisely to the half revolutions of those in the other.

It will thus be seen that one of the motors sets the pace for all the others and becomes a controlling agency by which the speed of all the others is regulated, any variation in the speed of one being instantly accompanied by a similar and equal change in the speed of the rest.

Such in brief is the synchronizing device, and it will be recognized as a new departure in the fact that the *synchronous* motion of distant machines is secured without either machine being *isochronous* in itself, the machines following the governing motor at speeds varying from 100 1,000 revolutions per minute.

The electric motors in practice have a vertical axis and on top of each one is a segmental distributer, and to the armature spindle of each machine is secured a trailing brush which sweeps over the distributer segments. For the sake of clearness these trailers are shown geared to the motors in the diagram, but in practice they are secured to the spindle itself and the entire system has thus but a single moving part.

In the system of transmission here described the synchronizing current is constantly maintained upon the line, and by a simple system of connections it is made to serve also for the transmission of signals without in any way affecting its operation as a synchronizing current. It will be observed that as the vibrating tongue of the relay at *X* puts the opposite halves of the split line battery to earth alternately, and that as this change takes place at periods of a half revolution of the armature of the machine, one-half the circumference of the distributer over which the trailer sweeps at each station will correspond to a transmission of positive currents to line from battery $L^1\,B^1$, and the other half will correspond to a transmission of negative current. Or, in other words, while the trailer is sweeping over one-half the circumference of the distributer one part of the split battery $L^1\,B^1$ will be connected to line and earth, and while sweeping over the other half the other part will be in circuit, each in turn sending a current



PATTEN'S MULTIPLEX TELEGRAPH SYSTEM.

where it is conducted to earth at E^1 through the wire 13, the trailing brush Tr^1 and other connections.

It follows that as the motor armature $A^1\,A^1$ revolves, the vibrating armature v^1 of the polarized relay P^1 will move rapidly back and forth, beating the half revolutions of the armature $A^1\,A^1$, and at each half revolution this vibrator will send a pulsation of current alternately positive and negative over the main line $M\,L$ to the distant station from the line battery $L^1\,B^1$, to which it is connected through the contact stops $e^1\,e^3$. At the distant station *Y* or any terminal or way station the main line $M\,L$ passes through the coils of another polarized relay P^2, and the armature of this polarized relay will vibrate in unison with and respond to the vibrations of the relay at station *X* as the alternating pulsations of current are transmitted by the latter over the line from the battery $L^1\,B^1$, and the relay P^2 at *Y* will therefore beat the half revolutions of the armature

of opposite polarity. Some arbitrary line, as Q^1 U^1, may therefore be drawn diametrically across the distributer at X, and it may be assumed that while on one side of this line the trailer, moving always at the same rate of speed as the motor armature A^1 A^1, is connecting one-half the battery L^1 B^1 in circuit, and when upon the other side of this line it is connecting the other half. It is further evident that by making this segmental distributer movable about its axis this line Q^1 U^1 may be made to fall within the broad spaces $E+$, $E-$.

The distributer is composed of two parts; one of these, $E+$, $E-$, is connected direct to earth. The other consists of insulated segments 1+, 2+, etc., 1—, 2—, etc., which are grouped in two opposite quadrants of the distributer. Whenever the trailer is on any part of $E+$ or or $E-$ the battery has a free path to earth through the trailer Tr^1. The insulated segments are connected to the different local branches in pairs, each local branch having two such diametrically opposed segments, located in opposite halves of the distributer. The connections and instruments in circuit are identical for all the branches; a description of one will therefore suffice.

Each local branch has a double line to earth ending in opposite halves of the distributer, as shown at 5 + and 5 —, and the two local branches terminating in these segments are connected to switch centres W^1 and W^3, both of which may be turned to either one of three contacts, R^1 and R^3 for receiving, Sd^1 and Sd^3 for sending, and Sy^1 and Sy^3 for synchronizing. When on the latter contact the current has a direct path to earth without traversing any of the sending or receiving apparatus, but when upon either sending or receiving contacts, the current from the battery L^1 B^1 must go to line and earth through the polarized relay R^1 and through one of the contacts S^1 or S^3, depending upon the position of the key K^1, which is an ordinary two-point key, the receiving relay R^1 being connected to its middle point. The drawings represent station X sending and station Y receiving, the switches indicating the respective functions of the apparatus at the two stations. Thus if the key K^1 at X be depressed so that its front contact will be in contact with the stop S^3, the circuit l^1 l^1 will be thereby put to earth through the relay R^1, and this relay will be actuated, its tongue v^3 will shift over to d^3 and will remain there while the key is held depressed. At the same time the circuit l^3 l^3 will be cut out, and every time the trailer Tr^1 comes around to the contact 5 + a plus current will be sent through this relay to line and earth; but only the first of these will affect the relay R^1. If now the key be raised and its back contact be brought in contact with Sd^1, then as soon as the trailer Tr^1 reaches the segment 5 — a negative current will be sent to earth and line through the relay R^1, and it will return to the position shown. Evidently these motions will be repeated in the relay R^3 at station Y, and signaling may thus be effected by causing these polarized relays to close the local circuit of a sounder D^1 and D^3 at the two stations.

Thus, if the key were closed at both front and back contacts the receiving relays would all vibrate in unison with the synchronizing relays at the station, and transmission is effected by cutting out all the plus or minus impulses according as to whether the key is held upon its front or its back contact, the opposite impulse being then allowed to act continuously. The contacts may, of course, be multiplied to insure certainty of action.

On the Relative Proportions of Ring Armatures.

BY R. S. DOBBIE.

Being a great admirer of the ring armature, the value of which the French Senate and Chamber worthily acknowledged by awarding the Volta prize to M. Gramme, I think that a few remarks on the proportion of the radial depth to the axial length would be interesting to many readers of this journal. In the design of a dynamo, the mass of the armature is the first thing to be taken into consideration. A given weight of iron can be arranged in many ways, each of which under similar conditions of peripheral speed can give equally good results. For instance, the performance of an armature in which the radial depth of core is half the radius, and placed in a system of magnets adapted for it, can be equaled by an armature in which the radial depth is, say, one-tenth the radius of ring, the fields in this case also being adapted to it, and the conditions of speed, mass and total strength of magnets, being the same in both. And not only does this hold good here, but also with the drum armature, which I look upon more as a modified Gramme ring, in which the radial depth of core nearly equals the radius of the armature, than a modified Siemens shuttle armature; a drum armature with equal speed and field can be strictly compared with one of the ring type of equal mass.

The core of any armature has three important functions to perform. First, to use a conventional term, it acts as a path for the lines of force from the field magnet; second, it has magnetic lines of force induced in it by the action of its own coils; and third, it acts as a support to these coils. Each of these functions involves the following conditions respectively: First, the path for the inducing magnetism from the fields, and hence the surface presented to the pole pieces, *must be large;* second, the lines of force generated in the armature *must be few;* and third, the shape or proporiton of the ring influences the *length of a convolution* compared to its mass. Since the circle is the shortest line which can enclose a given area, theoretically considered the circle should be the section of a Gramme ring; but the difficulty of constructing this shape has led to the almost universal employment of rectangular sections, with the corners rounded for conveniece of insulation and winding. Let us now consider the effect of lengthening the rectangular section in proportion to the radial depth of the ring. We have here six rings, Figs. 1 to 6, in which the section al area a (= 16 square inches) and the mean radius $m\,d$ (= 12 inches), are equal in all the rings. It will be seen that the length of one convolution l creeps up in a startling manner, and it is obvious that if this were the only consideration, the square section (barring the circle as impractical) should be selected.

But there are other points before us, such as the clear-

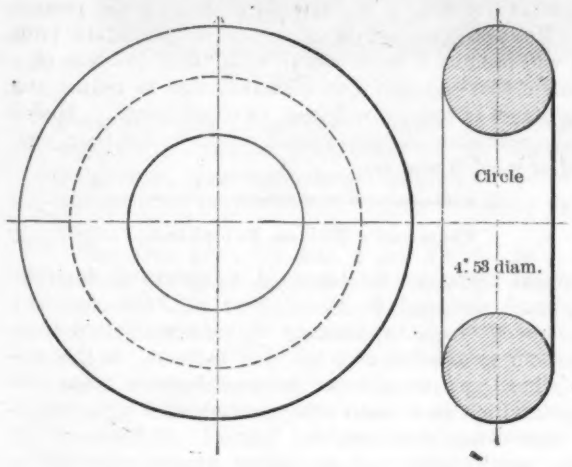


FIG. 1.

D = 16.53 inches.
d = 7.44 "
$m\,d$ = 12.0 "
l = 14 inches.
a = 16 square inches.

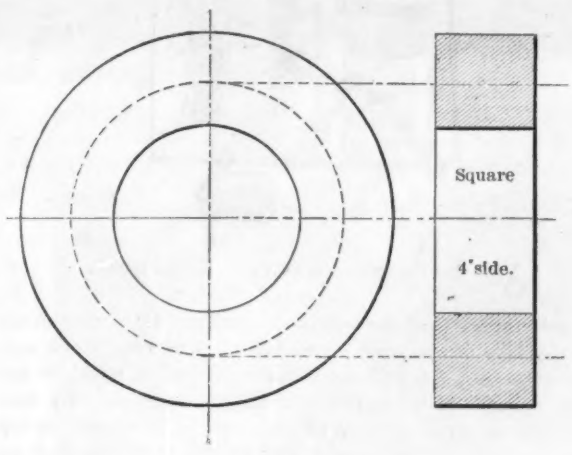


FIG. 2.

D = 16 inches.
d = 8 "
$m\,d$ = 12 "
l = 16 "
a = 16 square inches.
p_1 = 100 " "
p_2 = 150 " "
p_3 = 250 " "

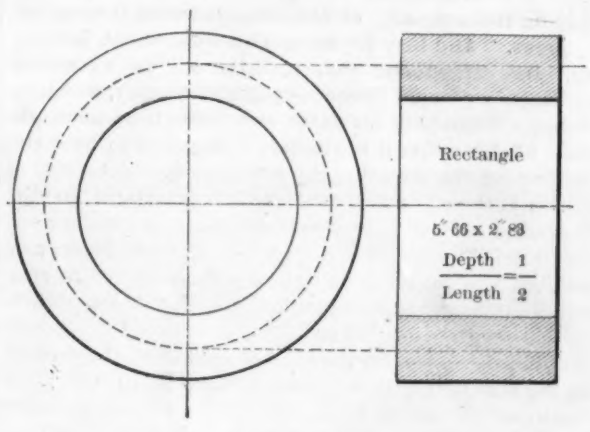


FIG. 3.

D = 14.83 inches.
d = 9.17 "
$m\,d$ = 12.0 "
l = 17.0 "
a = 16 square inches.
p_1 = 131 " "
p_2 = 212 " "
p_3 = 238 "

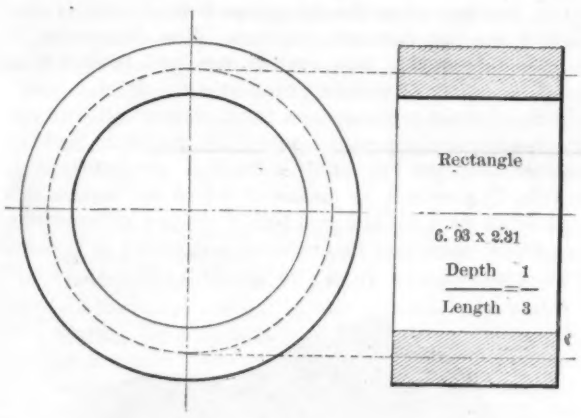


FIG. 4.

D = 14.31 inches.
d = 9.69 "
$m\,d$ = 12.0 "
l = 18.5 "
a = 16 square inches.
p_1 = 155 " "
p_2 = 260 " "
p_3 = 243 " "

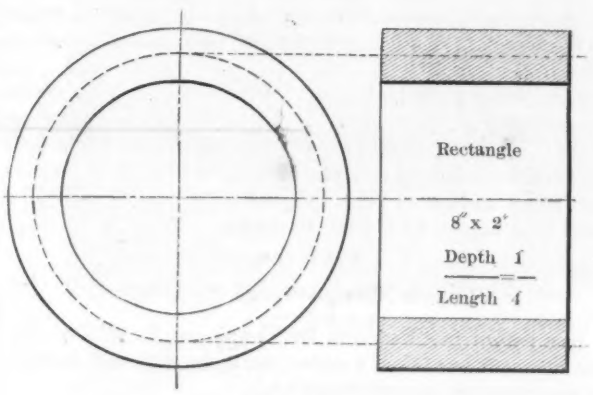


FIG. 5.

D = 14 inches.
d = 10 "
$m\,d$ = 12 "
l = 20 "
a = 16 square inches.
p_1 = 162 " "
p_2 = 287 " "

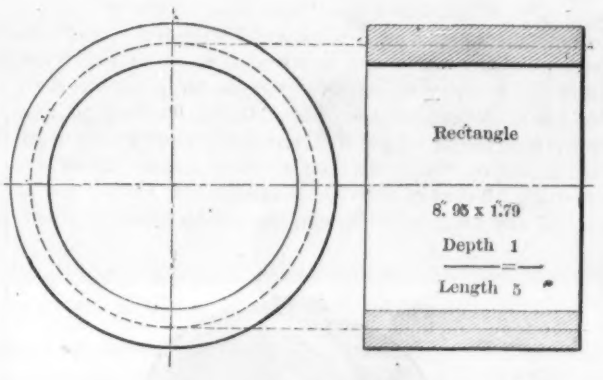


FIG. 6.

D = 13.79 inches.
d = 10.21 "
$m\,d$ = 12.0 "
l = 21.4 "
a = 16 square inches.
p_1 = 191 " "
p_2 = 333 " "

D, external diameter of ring.
d, internal diameter of ring.
$m\,d$, mean diameter of ring. } Equal in all the figures.
a, area of cross section.

l, length of one turn of wire.
p_1, total area of pole pieces embracing 50 per cent. of outer periphery only.
p_2, total area of pole pieces embracing 50 per cent. of outer and inner periphery.
p_3, total area of pole pieces embracing 50 per cent. of outer periphery and the two sides.

THE RELATIVE PROPORTIONS OF RING ARMATURES.

ance between the core and pole pieces, which I will call the inductive space and which must be small in a radial direction and large in area. For the sake of illustration and comparison we will suppose that 50 per cent. of the angular breadth of the ring is covered respectively by pole pieces, first on the outside surface only, as usually practiced, which area is designated by p_1 in the tables accompanying the figures; second, by pole pieces on the outside and the two sides, as in Mordey's dynamo, and designated by p_2; and third, by pole pieces on the cutside and inside, as in the Fein and Sperry dynamo, and designated by p_3. It will be noticed that at the stage of elongation shown in Fig. 4, the value of p_3 ceases to be larger than p_2. It will thus be seen that the longer we make the ring, the greater is the surface presented, but so, also, is the length of one convolution l.

As the ring, as just stated, serves as a path for the magnetic lines of force, it is evident that the area of the field should be in proportion to the area of the armature, and the area of the pole pieces should also be proportional to a given area of field magnet. This latter point is one that I have never yet seen any hard and fast rules laid down for. Now, theoretically, it is evident that the sectional area of a field magnet should be equal to twice the area of the ring (remembering that in every ring the lines of force

from the field magnets have two available paths). For example, those shown in the figures being 16 square inches, the field magnet should be 32 square inches; that is, supposing that things could be so arranged that all the lines of force from the field magnets could be utilized in the armature, and, of course, assuming that the saturation was the same in both. In practice, the magnets are generally made of metal inferior to that of the armature; but as the latter contains quite a percentage of inert matter in order to carry out the necessary lamination, and as constructors are more and more awakening to the fact that wrought-iron magnets are cheapest in the end, the balance becomes more equal; so that in the end we can, in practice, allow only for a waste of lines of force, and, if indeed it is worth while, a little difference in favor of the superior metal that armatures are usually made of.

From my own observation I have found that the area of the armature, multiplied by two, is ample, if the field magnets are of wrought-iron and the length of the inductive space is small (not exceeding ⅛ inch, in the above example). The fields should be nearly, if not quite, saturated in order to insure steadiness; but the magnetism induced in the armature should be considerably short of saturation, as an armature will heat even if laminated, should it be magnetized to saturation, thus still further reducing the necessity of difference between the respective areas. And here let me make a note about lamination. It is often found that constructors use extremely thin sheets separated by the very thinnest paper, which by no means *thoroughly insulates* one plate from its neighbors. I believe that it is a useless refinement to have the disc forming the armature thinner than one-sixteenth of an inch. If these are really substantially insulated, so that after being turned true the plates have a resistance of over 10,000 ohms between each other, or, more practically speaking, will not allow an ordinary magneto bell to ring through, it can be relied upon that *insulated lamination* has been properly carried out.

Taking, therefore, for the sake of argument, the ground that the area of a field magnet is twice that of the ring, let us return to the question, How large should the surface of the pole pieces be? Referring to the figures, and assuming that 50 per cent. of the angular breadth is enclosed by pole pieces, we then have for the different shapes, ignoring the circle as impractical, the values shown in the tables accompanying each diagram.

So many machines have the surface and also angular breadth of the pole pieces so enormous, compared with the section of the field magnets, as to be simply ridiculous. On such machines I need hardly add that the "beautiful spark playing around the brushes" that is so much admired by country cousins is ever present. There is no doubt that the present tendency is in the direction of narrower pole pieces. I do not remember seeing a continuous current machine in which the area of pole pieces was less than 1.5 that of the field magnets, and I have yet to hear of any machine being condemned on account of having the area of the pole pieces too small. I know from practical experience that about 60 square inches of pole piece is ample for a magnet about 6 inches in diameter, *i. e.*, 28.2 square inches, and four such magnets and pole pieces could be presented to the square section ring, the pole pieces embracing the outer periphery and the two sides (p_3).

FIG. 1.—CLAMOND'S BUTTON TELEPHONE.

I think that modern practice in alternating current dynamos where the area of the pole piece frequently equals the area of the field magnet, might be at least considered in the construction of continuous current machines, as both are fundamentally the same in principle. The resistance of the inductive or air space is overrated by constructors, as the many examples we can all call to mind show that after a certain limit is reached, it is useless, and even detrimental, to go beyond; but the angular breadth can be reduced with advantage, and *more poles may thus be presented to the ring.*

One more point is brought out by comparing the figures. The difference between the internal and external diameter of the square-section ring, Fig. 2, is far greater than in Fig. 5, and if both were wound with, say, one layer of wire, inside and out, with no overlapping, the difference in number of turns would be 20 *per cent. in favor of the long ring*, Fig. 5. It will thus be seen that while the length of a coil becomes greater as the ring increases in length, so does the internal diameter of the ring, thus allowing a greater number of turns, or a thicker wire, to be used.

Referring again to Fig. 2 and Fig. 5, we have 16 in. and 20 in., respectively, as the length of one turn; that is, a difference of 20 per cent. in favor of the square section, Fig. 2; and as the electromotive force is proportional to the number of coils, and the current is proportional to the resistance, we have things balanced, and only have to choose between the difference of constructional advantages in them.

In conclusion, it will be seen that the various forms have their own peculiar advantages. The square section has

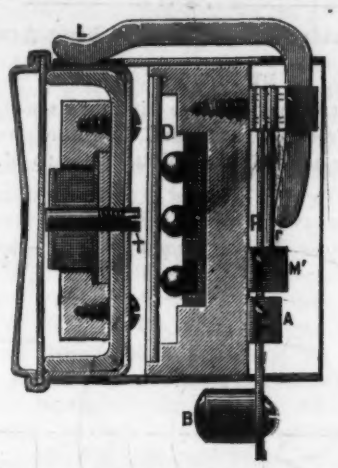


FIG. 2.—CLAMOND'S BUTTON TELEPHONE.

the advantage that the length of one turn is a minimum for the area of the mass enclosed. If the pole piece embraces the outer periphery and the two sides with 50 per cent. angular breadth, the area offered is ample. In rectangular sections the area of pole pieces increases faster than the length of one turn. The winding is more symmetrical and lamination is more easily carried out; but if the length is increased beyond a certain limit the length of a turn becomes objectionable.

These questions will afford ample exercise for those inclined to grapple with them. So many minutiæ are involved, that a careful consideration of the conditions to be fulfilled is very necessary to success, and opinions as to the advantages of the various forms can by no means be given off-hand.

The subjects touched upon in this paper suggest many others, such as the number of poles, length of inductive space, and its relation to area of pole piece and area of field magnet, together with the ratio of radial depth of core to the mean radius of ring. These are subjects that give abundant material for further study.

Lugo's Novel Storage Battery.

In a patent just issued to Dr. Orazio Lugo, of this city, the inventor has taken a departure from the usual method of constructing storage batteries.

The invention is based upon the idea of storing the gases, hydrogen and oxygen, evolved during the process of charging, and is, therefore, properly speaking, a gas battery, there being, substantially, no chemical action involved. That is to say, the material used as electrode is not chemically attacked, as is the present forms of storage batteries. The electrodes consist of finely divided or allotropic lead, each atom of which is coated or covered completely with soft or spongy copper. This material is, therefore, not oxidizable under the influence of the charging current. It is packed around conducting plates, and immersed in an electrolytic solution.

In charging, the gases accumulate around the atoms of the masses, which atoms act as nuclei therefor. The cell appears to be an actual storage battery in the sense that something is stored, viz, the gases.

The Steam Engine.

On the evening of Jan. 17, Mr. Edward N. Dickerson, the well-known lawyer of this city, delivered an admirable address before the New York Electric Club on "The Steam Engine, its Principles, its Development, its Present Capacity, and its Future Perfection." The lecturer began his address by referring to the discoveries in magneto-electricity of Henry and Faraday, and the invention of Pacinotti, which, in connection with the steam engine as the source of power formed the basis of a large and ever increasing method of power distribution. After mentioning the steam engine of Hero of Alexandria, the lecturer brought forward the work of the true inventor of the steam engine of modern times—James Watt—and showed how he recognized and applied the true principles governing its action, and embodied in his machines rules that are to-day recognized as standard all the world over, notwithstanding the oft-repeated attempts to upset them.

According to the lecturer, two conditions are essential to a perfect obedience of these laws, viz.: 1. The valves of the engine must be absolutely tight when closed. 2. The closure of the steam valve, when time for cutting-off has arrived, must be instantaneous. With these two conditions, the engine in other respects being practically perfect, the theoretical conditions will be practically attained. Mr. Dickerson laid special stress on the great loss due to leaky steam valves, which was caused largely by the employment of the balanced valve, instead of the single poppet valve of Watt; and he asserted that, on an average, every steamboat running in the waters of New York is wasting not less than 15 per cent. of all the fuel consumed simply by leakage through the valves.

Regarding the future of the steam engine, the lecturer remarked that perhaps the limit to which pressure can be carried practically, with our present knowledge of material and of construction, is 250 pounds to the square inch; at which steam may be expanded one hundred times, when it would give $5\frac{6}{10}$ times as much power as without expansion. Under those circumstances, a horse-power should be made with about three-quarters of a pound of coal an hour, and so far as could be seen at present, that was about the limit of economy attainable, and that would give us about one-quarter of the power of combustion in dynamic effect, as compared with the one-tenth which is all that is at present obtainable.

The lecturer was of the opinion that with our present knowledge of machinery a steam engine would be built that will produce a horse-power with three-quarters of a pound of coal an hour, if of sufficient size to reduce the percentages of loss by radiation to a minimum. Under those circumstances fuel expense would be less than one-third of what it now is.

Clamond's Button Telephone.

Several years ago we described a system of domestic telephony, designed by Dr. C. Herz, of Paris, specially for domestic uses, as a means of communication from one room to another of a house or factory. In this system what was termed a "button telephone" was employed, which in a small compass embodied both receiver, transmitter and switch. Recently M. Clamond, of Paris, has brought out a similar apparatus, which is described in *l'Electricien*. As will be seen in the accompanying illustration, the whole apparatus is contained in a cylindrical tube of 6 cm. diameter, the microphone forming the back part of the closed tube, whilst the receiver forms the cover. The latter is pulled out and held to the ear when the telephone is used, and is constructed like an ordinary receiver. The diaphragm of the microphone is a thin carbon disc, and behind it is placed a piece of carbon provided with circular holes. In each of these holes rests a small carbon ball, and the microphonic contacts thus formed are stated to be very sensitive, and are not easily disturbed. At the back of the tube is a switch, by means of which the current can be made to pass to the call-bell or to the microphone. The switch consists of two rods r and R, acting as springs, which are insulated from one another. The upper end

FIG. 3.—CLAMOND'S BUTTON TELEPHONE.

of the bent lever L fits into a slot of the tube; the two copper strips M^1 and A complete the apparatus.

When the receiver is in a state of rest, *i. e.*, pushed into the tube, it lifts up the front part of the lever L and presses the other end of the lever against the spring r, bringing the latter into contact with R. In this position the current coming from the calling station passes through the call-bell and rings it. On pressing the button B contact is made between spring R and the piece A, and the current passes to line. On pulling the receiver out of the cylindrical tube and holding it to the ear, the front part of the lever L falls downward, and the spring is pressed against M^1; the microphones and the receivers of the two connected stations are now in electrical communication, and conversation can be carried on.

True and False Economy in Central Station Construction.

To the Editor of The Electrical World:

SIR: The great statesman, Edmund Burke, once wrote to one of England's peers, who attacked him upon the subject of his pension: "Economy consists not in saving,

FIG. 1.—THE OMAHA & COUNCIL BLUFFS ELECTRIC RAILWAY.

but in selection. Parsimony requires no providence, no sagacity, no powers of combination, no comparison of judgment. Mere instinct, and that not an instinct of the noblest kind, may produce this false economy in perfection.

The true economy has larger views. It demands a discriminating judgment, and a firm, sagacious mind. It shuts one door to impudent importunity, only to open another and a wider, to unpresuming merit." The quotation is full of wisdom and truth, and the force of the words must strike every thinking man, and cause him to stop a moment and consider why "economy consists not in saving, but in selection;" why "it demands a discriminating judgment, and a firm, sagacious mind," while "parsimony requires no qualifications whatever," and why "it shuts one door to impudent opportunity, only to open another and a wider to unpresuming merit."

Nothing in the past few years has so well demonstrated the results of true and false economy as the equipment of electric light plants. Take the list of companies that have been organized in the Eastern States alone. How many can be picked out as having earned dividends on their original investment? The percentage of plants that have made returns is wonderfully small as compared with the number in operation. Is it difficult to trace the cause?

Is a searching investigation necessary to discover the reason of the deficiency? I think not. Let the directors of electric light companies ask themselves whether they are not to a large extent, if not wholly, responsible for defeating the aims that they had in view when organizing by exercising an economy in the equipment of their plants which consisted in saving rather than in selection. Did they obtain, first, the best engineering ability to design the plant, and, secondly, give the contract for its equipment to the manufacturer with a reputation for doing good work and turning out only first-class machinery, and who thoroughly understood the requirements necessary to the profitable running of the plant? or did they adopt a short-sighted and parsimonious policy, employ second rate engineers and accept the figures of the lowest bidder, who is always prepared to agree to any specifications for the sake of the contract, knowing full well at the time that it is impossible to live up to the letter of the specifications except at a great loss? No instance, I believe, has yet come to light where such loss is known to have been sustained. And what has been the result? The electric light companies suffer by the installation of cheap machinery and by work done badly.

Experience is sometimes a dear teacher, but it has convinced many electric light companies that economy consists not in saving but in selection of the best in the beginning, which is always the cheapest in the end.

The designing and equipping of electric light plants is special work and should only be placed in the hands of those who make a specialty of the business, and who from long experience are thoroughly familiar with its details and are competent engineers in laying out power transmission machinery.

Again only the finest quality of material should be used in the manufacture of the machinery for the plant, as the work of driving dynamos is constant and hard. It is always preferable, when possible, to contract with one concern for the complete equipment of the power plant, calling upon manufacturers of financial strength, who furnish every requirement, and who are at the same time experienced in electric light work. Giving out work piecemeal to a dozen concerns never insures a successful and satisfactory plant.

All work should be fitted and tested in one shop, and if any trouble occurs after erection of the machinery in the station, there is a single manufacturer responsible.

It must be admitted that there are to-day few concerns who are capable of designing and equipping stations with a view to obtaining the most economical and best results, while there are far too many who have put themselves forward resting upon a foundation wanting in experience and general security.

To this latter class, who represent "impudent importunity," the door should be shut, only to open another, and a wider, to unpresuming merit."

Selection, the exercise of a discriminating judgment, and a policy set against parsimony, will produce true economy, which every electric company should practice in the equipment of their stations, and the sooner they do, the quicker will they reap the fruits of their investment in the shape of dividends.

A SHAREHOLDER.

NEW YORK, Jan. 19, 1889.

FIG. 3.—THE GENERATING PLANT, O. & C. B. ELECTRIC RAILWAY.

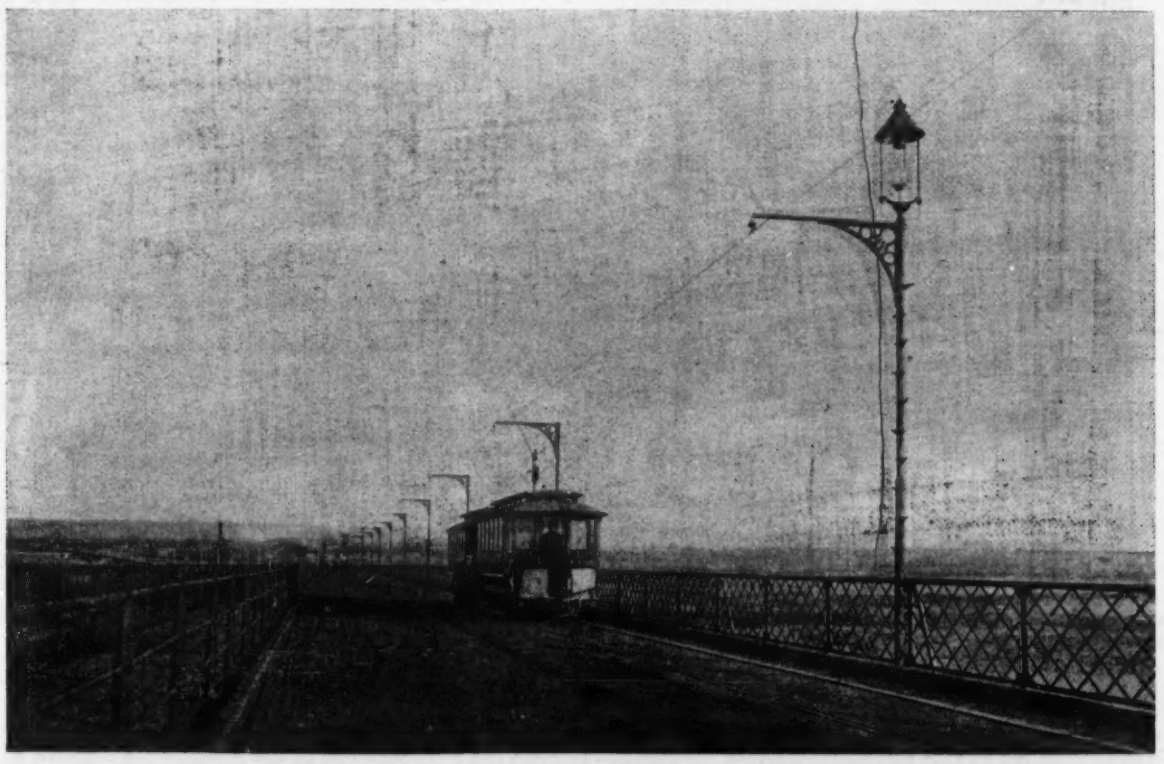


FIG. 2.—THE OMAHA & COUNCIL BLUFFS ELECTRIC RAILWAY.

The Omaha & Council Bluffs Electric Railway.

We illustrate on this page the new electric road running between Omaha and Council Bluffs, of which descriptions have already appeared in our columns. The Omaha & Council Bluffs Railway and Bridge Company started their cars the last of November, and since that time they have been in daily operation in a way which has been to the utmost satisfaction to the owners and to the general public, which is more than pleased with this new means of rapid transit which the road has opened between Omaha and Council Bluffs. The cars on this road are run faster than any other in the country, a speed of fifteen and oftentimes twenty miles an hour being attained. In the accompanying illustrations, Figs. 1, 2 and 3, are shown views of the road and the power station. The power plant consists of two 30 and one 40 h. p. generators. This is the finest electric railway in the West to-day, and shows in every detail of construction and operation the excellence of the system.

Light Without Heat.

To the Editor of The Electrical World:

SIR: Owing to the frequent remarks in your editorial and other columns within the last few months upon the subject of obtaining light without accompanying heat, I am induced, as a matter of protection, to place before you and the public my own claims upon the subject. My work in this field was commenced in the latter part of 1884, and especially early in 1885, and has been continued, in one form or another, up to the present date. It is quite evident that when an electric current is passed through a filament a part of its energy appears in the form of useful light, and the remaining, and larger, part in the form of heat. But as light can exist and perform its various lumin-

ous, chemical and electrical effects without the aid of heat, the latter, when emitted from the filament, is a total loss of electric energy. I have at present two or three methods, with their modifications in a more or less completed form, for overcoming this difficulty, and it is the expectation in the near future to produce a lamp the illuminating parts of which can be handled with impunity, while the same is giving forth a brilliant and soft light. Perfection will be reached when the filament will remain absolutely cold while under full action. A modified source of electricity is used in some cases with these lamps, as well as other sources of energy. The filaments are made in various shapes, some of them not at all resembling those we are accustomed to see, while in a few of the improved lamps none are used. The color of the light emitted can be varied through the entire spectrum in certain forms of lamps.

In his late address Professor Brackett mentioned the idea of casting polarized rays of light upon the proper conductor, and causing an intermittency or alternation of an electric current. Now this is almost exactly the method shown by my drawings, and described in my papers of 1884 and 1885, except that the idea is there shown more developed. Some interesting facts in connection with this will be brought out sooner or later. A large quantity of accessory apparatus and different methods have been devised which necessarily cannot be mentioned here.

Finally I would like to put on record the fact that I have at least four distinct, and what it is thought to be practical, methods of generating electricity otherwise than by dynamos. The object of writing the above is as a means of protection, both from previous and future investigators. Progress has been greatly hindered from the beginning, and is at present, from the lack of funds necessary to perfect and introduce work of such new character and large dimensions, otherwise commercial results might possibly have been obtained about one year ago.

A. B. WORTH.

GREENPORT, L. I.

The Electric Railway at Washington, D. C.

We show herewith two views, Figs. 1 and 2, of the Thomson-Houston electric road at Washington, D. C., a leading feature of which is the novel method of placing the pole line in the middle of the street. The Eckington & Soldiers' Home Railway at Washington has been in operation since the latter part of October, and thus far without a hitch of any kind that can be laid to the electrical apparatus. The patronage of the road has increased to such an extent that it has been necessary to double the car capacity. Each motor car now tows an additional car, and both are filled to their utmost capacity at every trip. The road is one of the finest of its kind that has been built in the United States, and one which reflects the utmost credit upon the Thomson-Houston Company. It is not only attractive to street railway men, many of whom have been to Washington to study it, but is receiving an unusual amount of attention from Congressmen and others of like prominence.

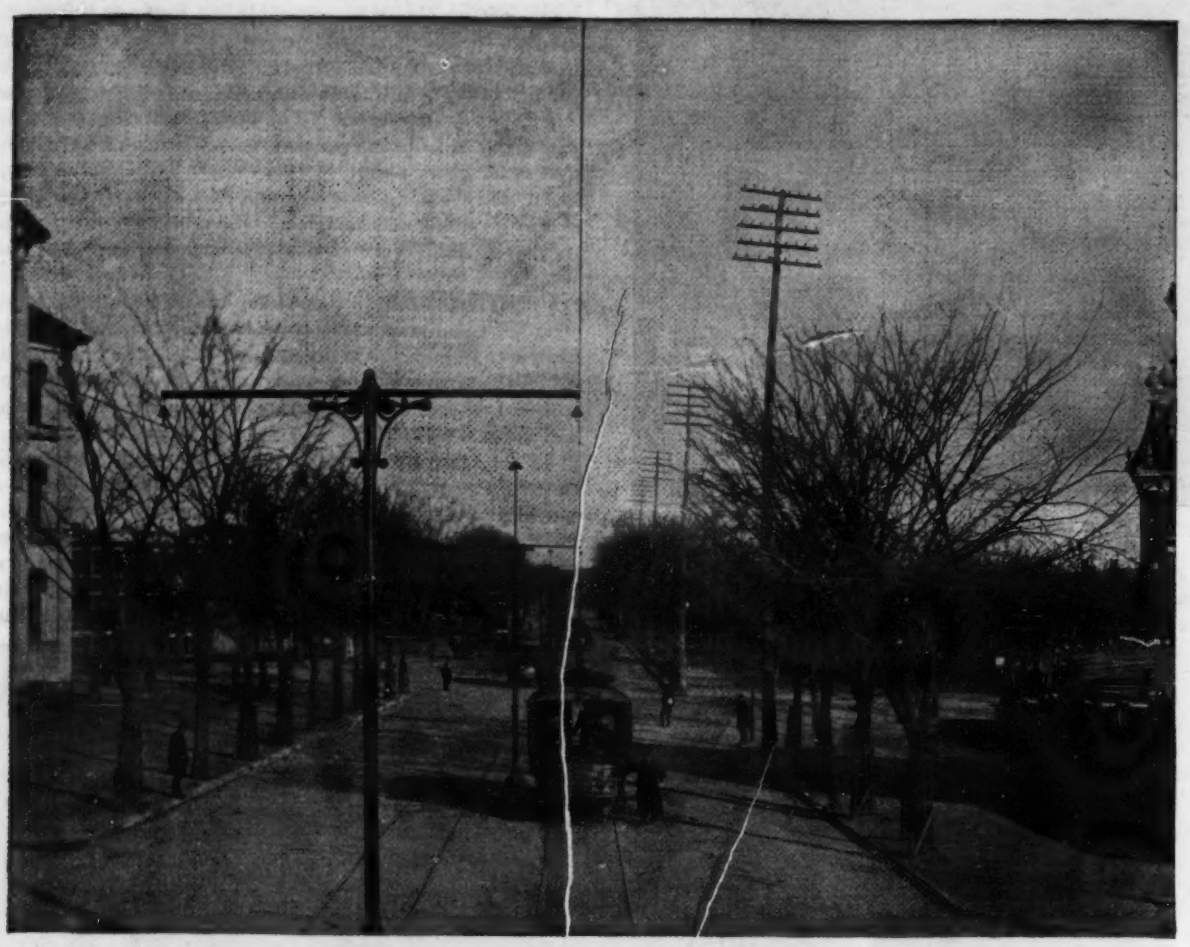


FIG. 1.—THE THOMSON-HOUSTON ELECTRIC ROAD, WASHINGTON, D. C.

Problems and Conditions of Ocean Telegraphy.*

BY JUDGE R. L. WEATHERBEE.

Here, in Halifax—always the station of the "repairing ships"—within sound of the sea, whose bed is covered with a net-work of electric cables, your readers feel interested, no doubt, in anything new in ocean telegraphy. For some time past an imperial subsidy has been proposed for a submarine cable to connect Halifax directly with the naval station at Bermuda. I venture to think it would be a misfortune if money should be pledged without due inquiry into a most interesting phase of this subject, to which, attracted solely in the interests of applied science, I have been led to give some attention.

Thirteen cables have been laid across the Atlantic at a cost of not less than fifteen millions of pounds sterling. There are at this moment about 7,000 miles of this property lying abandoned. Besides the loss entailed by interruptions in traffic, prodigious sums have been expended in repairs. In one official report I read that one hundred thousand pounds sterling was spent within a year over one cable. Adding to the £15,000,000 cost the reasonable estimate of £5,000,000 outlay, for repairs and damages due to breaks and faults, we have here an expenditure of the enormous sum of, say, *one hundred millions of dollars*. Three of the cables are useless and abandoned, and it has been doubted whether the average life time of a submarine cable can be computed at a greater period than 12 to 14 years.

I have closely examined the evidence from time to time collected, and I will venture confidently to assert—having had experience in weighing testimony—that these serious results are due to the use of *iron* in the manufacture of the cable. It has, from the very first, been doubted whether they should not have been made without iron by covering the *gutta percha* core with *hemp* alone, instead of iron and hemp. There has always been a controversy. During the whole period the eminent men engaged in the discussion have been awaiting the further experience of such men as come in and go out of our port to repair these cables. To those men who have been struggling with terrific winter storms in constantly lifting up the cables from the bottom of the ocean—often a depth of over two miles—cutting out miles upon miles of defects, and repairing and laying them down again, the world owes much for the advancement of ocean telegraphy and its results.

The world owes them much because they have demonstrated that, instead of sinking millions in a perishable type of covering for the copper thread through which day and night throbs instantaneous communication with the old world, we may have a practically imperishable covering which will vastly cheapen and thereby multiply submarine communication. In the deep solitude of the ocean bed, as I learn, all is still. There is not sufficient motion to break a gossamer thread. Science might safely have predicted, even if hemp armor was not stronger than an iron one, that here hemp, which no rust could corrupt, would withstand the action of the ocean and the mineral and vegetable slime which covers the floor of the ocean. Practically, at any rate, as an electric journal informs us, an Atlantic cable, broken in 1887, was, during the past summer, restored by the insertion of fifty miles of core with a pure hemp covering, made at the suggestion and under the direction of the inventors. So much for the deep water.

Though not generally known, for eight years past Halifax has been connected with the town of Dartmouth by a submarine core covered with hemp alone sunk in shallow water, where, since rock more frequently occurs, corrosion constantly proves fatal to iron. This cable, subjected to all the dangers incident to shore ends, is now as perfect as when made, has never been repaired and is not likely to need repairs for half a century. In these conditions what would have been the fate of an iron cable? No doubt it would have long since succumbed. What would not the owners of one of the Atlantic lines afford to give if their property might, by some mysterious agency, be transformed into this type?

In a word, iron can endure in the ocean but a few years. Before me is the account, written by a superintendent in Ireland of one of the great companies, concerning a shore end weighing 20 tons per knot, covered with solid iron rods half an inch in diameter, eaten up in short lengths of 2 feet to 2 fathoms, the cable being held together by the

FIG. 2.—WASHINGTON ROAD, SHOWING CENTRAL POLE WITH LAMPS.

*Halifax, N. S., Chronicle.

bare core. "Several pieces were recovered where every one of the iron rods was eaten through, and their ends tapered to points as sharp as bradawls." In lifting this cable—eaten up by galvanic action on the metals, of the bottom—the naked core had to bear the entire weight. Numerous trustworthy reports which I have, besides actual observation, support this testimony, and intensify the suggestive contrast of the writer that "a hempen hawser could not possibly have met with such a fate."

Here on my shelf is a specimen of hempen yarn from a hawser submerged for 79 years in this harbor as sound and strong and bright as new yarn. And it is well known that hemp recovered from the rigging of the Royal George, sunk in 1782, is as perfect as when submerged.

The iron wire is needed for no purpose. The hemp is tough, and, owing to the new method now used of laying it up, a cable will not shrink or kink, and when repairs are required it can easily be raised from vast depths in which a corroded iron one would at the first flaw have to be abandoned. I will add that there is scientific authority that the new cable will insure increased speed by avoiding a defect termed by electricians "induced magnetism," attributable to the presence of iron sheathing.

To connect Bermuda with Halifax, an unusual ocean depth of 2,800 fathoms, or nearly 3½ statute miles, must be taken into account. Vastly deeper is the Pacific ocean, to span which Canada and Australia are relied on for assistance on the plea of promoting British consolidation. Doubtless without the success of submarine telegraphy the great question of imperial union would not now be worth mentioning. And it must all the more, I think, be remembered that those who are at present likely to apply for British or colonial gold to assist in submerging more perishable iron-sheathed cables are directly or indirectly interested in influential corporations whose capital is invested in making them. Money thus spent would be thrown away, as millions have already been hopelessly sunk. It can be saved by consulting thoroughly impartial scientific opinion and by proper inquiry.

In a few years at most an indestructible hemp-sheathed cable, so successfully working here at Halifax and so satisfactorily inserted at the bottom of the Atlantic, will be generally, I am sure, adopted in every part of the ocean, to bind closer and closer to the throne the most distant portions of the empire.

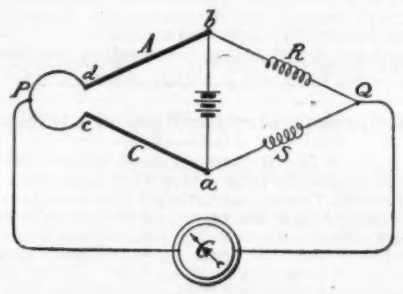


FIG. 1.

Tests of American Insulated Wires.*

BY GILBERT WILKES AND CARY T. HUTCHINSON.

Wire Tests.

The tests described in this paper were made at the Physical Laboratory of the Johns Hopkins University under the general direction of Dr. Louis Duncan. They were begun in February, 1887, and finished in December, 1888.

The wires tested were sent to us by different American makers, at Dr. Duncan's request, for the express purpose of being tested. We agreed to send them a copy of the tests. This copy was sent to every maker, but contained only the results for his own wires. We asked each maker whether we should put his name to the paper. Only two makers have consented to the use of their names. These were the senders of wires "B" and "D." One firm requested that not only its name but even the figures referring to its wires be left out. This firm sent the wires labeled "G." They declare that they have the best-fitted laboratory in the country for the purposes of wire testing, and that, as our results are at variance with theirs, they are consequently wrong. The other makers requested that their names be left out. It has been decided, in view of these requests, that the names be omitted from the descriptions of the wires; each maker is therefore denoted by a letter.

The figures given below for the insulation resistances are probably too high in nearly all cases, owing to the want of continuous contact between the more or less lumpy substances in the jars and the surface of the insulation. Further, the results for the same wire from day to day seem to change in a very erratic manner. This is explained in general by the state of the jar, whether wet or dry.

Description of Wires and Insulations.

Seven different specimens were received from "A." The following are the descriptions, including the maker's tags and our additional remarks:

A.

Specimen No. 1 A.—Tag: "16 B. W. G., D. B. & P. copper wire." We find: Diameter of insulation equals 3.78 mm., equals .121 in. Diameter of wire equals 1.58 mm., equals .062 in. The insulation is ordinary underwriter's.

Specimen No. 2 A.—Tag: "Lead encased; single conductor; cotton insulation; 16 B. W. G." We find: Diameter of lead casing equals 6.06 mm., equals .239 in.

Specimen No. 3 A.—Tag: "12 B. & S. or 14 B. W. G.; brown covered; hard drawn copper." We find: Diameter of insulation equals 5.58 mm., equals .220 in.; diameter of copper equals 2.12 mm., equals .083 in. This insulation seemed to have pitch in it; it burned with a great deal of flame and smoke.

Specimen No. 4 A.—Tag: "12 B. W. G.; brown covered; iron wire." We find: Diameter of insulation equals 6.4 mm., equals .252 in.; diameter of wire equals 2.67 mm., equals .105 in. Insulation is the same as No. 3 A.

Specimen No. 5 A.—Tag: "6 B. & S., D. B. & P. copper wire." We find: Diameter of insulation equals 6.44 mm., equals .254 in.;

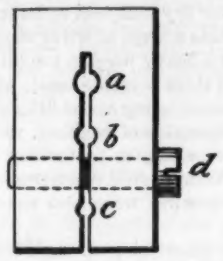


FIG. 2.

diameter of copper equals 4.04 mm., equals .159 in. Insulation was ordinary underwriter's.

Specimen No. 6 A.—Tag: "16 B. W. G.; red and white office wire." We find: Diameter of insulation equals 3.91 mm., equals .157 in.; diameter of copper equals 1.62 mm., equals .064 in. This insulation seemed to contain a great deal of paraffine.

Specimen No. 7 A.—Tag: "10 B. W. G., D. B. and P. copper wire." We find: Diameter of insulation equals 5.95 mm., equals .234 in.; diameter of copper equals 3.37 mm., equals .133 in. This was underwriter's insulation.

B.

Two specimens were sent by firm "B."

Specimen No. 1 B.—Tag: "No. 2,873; 100 feet; wire, 18 B. W. G.; insulation, 10 B. W. G.; braided; lot 011; insulation at 60 degrees F., per mile, 800 megohms." We find: Diameter of insulation equals 4.9 mm., equals .193 in.; diameter of copper equals 1.25 mm., equals .049 in. This insulation seemed to have a good deal of India rubber in it. It was quite elastic-could not easily be indented, and could be twisted indefinitely without breaking or leaving the wire. It was tough and rather hard to cut.

Specimen No. 2 B.—Tag: "No. 2,874—100 feet; wire equals 16 B. W. G.; insulation equals 8 B. W. G.; lot 011; insulation at 60° F., per mile, equals 1,600 megohms; unbraided." We find: Diameter of insulation equals 3.74 mm., equals .147 in.; diameter of copper equals 1.62 mm., equals .064 in. The insulation was the same as No. 1 B., with the exception of the braid.

C.

Two specimens were received, both uninsulated.

Specimen No. 1 C.—Tag: "No. 16 B. & S. G., bare copper wire." We find: Diameter of wire equals 1.27 mm., equals .050 in. This wire was remarkably soft.

Specimen No. 2 C.—Tag: "No 18 B. & S. G., bare copper wire." We find: Diameter of wire equals 1.01 mm., equals .040 in. This was exactly the same kind of wire as No. 1 C.

D.

Three specimens were received from firm "D." All were lead encased.

Specimen 1 D.—Tag: "196 ft. heavy lead; heavy insulation; 3 conductor; anti-induction." We find: Length of one side of the triangular lead casing equals 14.5 mm., equals .57 in.; diameter of insulation equals 3.88 mm., equals .153 in.; diameter of copper (mean) equals 1.62 mm., equals .062 in. The insulation was very sticky and seemed to contain pitch.

Specimen 2 D.—Tag: "150 ft. electric light solid conductor, 8 B. & S. G.; medium lead, medium insulation." We find: Diameter of lead casing equals 8.7 mm., equals .34 in.; diameter

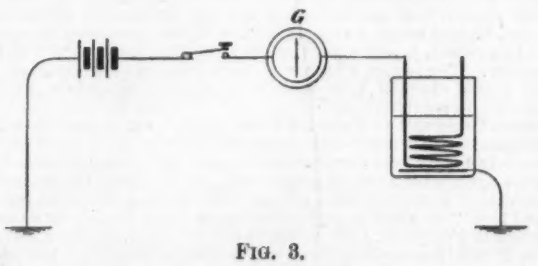


FIG. 3.

of insulation equals 5.95 mm., equals .234 in.; diameter of copper equals 3.25 mm., equals .128 in. Insulation was the same as 1 D.

Specimen 3 D.—Tag: "150 ft. bunched 25 conductor, 18 B. & S. G.; medium lead, medium insulation." We find: All 25 wires equals 12.55 mm., equals .494 in.; diameter insulation of one wire equals 3.04 mm., equals 1.20 in.; diameter of copper, single strand, equals .973 mm., equals .038 in. Insulation was the same as the former two.

E.

Two specimens were received from this maker.

Specimen 1 E.—Tag: "16 B. W. G., $\frac{5}{32}$ in., 200 feet." We find: Diameter of insulation equals 4.89 mm., equals .193 in.; diameter of copper equals 1.65 mm., equals .065 in. This insulation was rather hard and gave a clean surface on cutting; it was not tough, but could be dug out by the finger nail.

Specimen 2 E.—Tag: "18 B. W. G., $\frac{5}{32}$ in., 200 feet." We find: Diameter of insulation equals 3.92 mm., equals .155 in.; diameter of copper equals 1.22 mm., equals .048 in.

F.

One specimen only was received.

Specimen 1 F.—Seven strand cable, lead casing. We find: Diameter of lead equals 12.55 mm., equals .494 in.; diameter of insulation equals 9.29 mm., equals .366 in.; diameter, mean, of seven strands equals 1.62 mm., equals .064 in. This makes a single strand 16 B. W G., and all seven together are 8 B. W. G.

G.

Four specimens were received.

Specimen 1 G.—Tag: "Seven strand conductor, rubber and cotton insulation." We find: Diameter of the insulation equals 8.78 mm., equals .346 in.; diameter of mean of seven strands equals 1.55 mm., equals .061 in. This makes the conductor about 8 B. W. G.

Specimen 2 G.—Tag: "7 strand conductor, rubber and cotton insulation." We find: Diameter of insulation equals 11.09 mm., equals .437 in.; diameter, mean of seven strands of copper, equals 1.91 mm., equals .075 in. This makes conductor 6 B. W. G.

Specimen 3 G.—Single strand conductor; same insulation as former. We find: Diameter of insulation equals 3.79 mm., equals .149 in.; diameter of copper equals 1.28 mm., equals .050 in. This is 18 B. W. G.

Specimen 4 G.—Single strand conductor; same insulation. We find: Diameter of insulation equals 5.3 mm., equals .209 in.; diameter of copper equals 2 65 mm., equals .104 in. This is 12 B. W. G. This insulation was braided; the insulating material under the braid was remarkably soft, almost viscous.

Electrostatic Capacity of the Cables.

The capacity was measured by Thomson's method. In this method the cable and standard condenser are charged to such potentials that when they are connected their charges annul each other. We find the following to be the capacities:

Description of piece measured.	Length of piece.	Microfarads.	Microfarads per mile.
	Metres.		
1. No. 1 D, one conductor	60.3	.0154	.411
2. " 2d "	"	.01647	.439
3. " 3d "	"	.01697	.453
4. All there from sum of 1 + 2 + 3	"	.04884	1.304
5. " " " actual measurement	"	.0488	1.303
6. No. 2 D	46.0	.01685	.590
7. No. 3 D, 1st conductor	45.0	.0055	.197
8. " 2d "	"	.00557	.199
9. " 3d "	"	.00493	.176
Mean of 7 + 8 + 9			.191
10. All 25 conductors together	"	.0307	1.099
11. No. 1 F	3.43	.00109	.510

The measurements, Nos. 7, 8 and 9, were for three conductors taken at random from the twenty-five. As the twenty-five con-

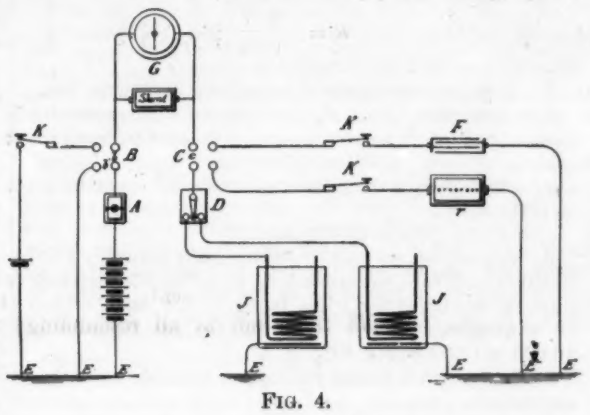


FIG. 4.

ductors are not symmetrically situated with reference to the casing, the capacity of the whole could not be expected to be twenty-five times the mean of three conductors taken at random. The three chosen must have been in the same or adjoining layers, since their capacities agree so closely. But in the case of the measurements of 1 D the sum ought to equal the capacity of the three measured together, since they are all symmetrical with respect to the casing.

Electrical Resistance of the Wires.

The resistance of the wires was measured by the Fleming modification of Wheatstone's bridge, Fig. 1. This particular bridge was the one used for comparing the resistances in Prof. Rowland's determination of the ohm. This bridge, as is well known, differs from the plain Wheatstone form, in that the ends *c* and *d*, instead of being joined directly and having the galvanometer wire *P* brought to them, are connected by the wire *c P d*. This wire is made of platinum iridium, and has been carefully calibrated. If now *b d* and *a c* are short circuited, we shall have, when a balance is obtained,

$$\frac{R}{S} = \frac{d\,P}{c\,P},$$

where *R* is the resistance of the wire, and *S* that of the standard. As *P* is movable along *c P d*, any ratio may be measured in this way. In the calibration the resistance of *b d* and *a c* is allowed for.

The resistance was usually measured at about 14° C. and at 0° C.; in some cases the lower temperature was not quite zero; but the measurements were always made for the purpose of checking the results, and in order to obtain the temperature co-efficient of the wire.

The ends of the wires were held in clamps made in the following way: A solid piece of brass, about 2 inches long and ¾ inch square, was split for about 1½ inches as shown in Fig. 2. A screw *d* was then put in to force the sides tightly together, and holes of different sizes were drilled as at *a b c*. The ends of the wires were put into these holes and clamped, so that the mark upon the wire, showing the end of the length measured, was just flush with the surface of the brass block. The wire and block were well amalgamated, and the whole block was then put in a mercury cup. There were, of course, two of these clamps, one for each end of the wire. It was necessary to take these precautions in regard to contacts, as the resistances were small, varying from .02 to .1 ohm. The lengths of the pieces were 11 and 22 feet approximately.

Complaint has been made as to the low conductivity given for certain wires; in some cases there is a difference of 3 or 4 per cent. between wires from the same maker. This is probably due to small flaws, which, although of no importance in a piece 1,000 feet long, would materially affect the resistance of so short a

*[The above investigation comprises tests which were made at Johns Hopkins University, in the Physical Laboratory, on insulated wires of American manufacture, to determine their conductivity, electrostatic capacity and insulation resistance, under varying circumstances. The manufacturers are simply designated by letters.—EDS. E. W.]

piece as 11 feet. The temperature coefficients afford a sort of check on the measurements; some are rather high and some low, but in the main they show that the measurements are substantially correct. The following table gives the results:

TABLE OF RESISTANCES.

Wire.	Nearest No. B. W. G.	Diameter. Inches.	Resistance per mile at 0°C. B. A. units.	Resistance per mile at 0° C. Legal ohms	Percentage. Conductivity.	Temperature coefficient per degree C. per B. A. unit.
1 A	16	.062	13.49	13.34	98	.0026
2 A	16	.064	12.66	12.52	99	.0029
3 A	14	.083	7.51	7.43	97	.0032
(Iron) 4 A	12	.105			14	
5 A	8	.159	2.08	2.06	97	.0039
6 A	16	.064				
7 A	10	.133	2.96	2.93	98	.0036
1 B	18	.049	22.38	22.13	94	.0048
2 B	16	.064	13.07	12.92	96	.0040
1 C	18	.050	20.9	20.67	97	.0041
2 C	19	.040	32.75	32.40	98	.0042
1 D	16	.064	12.96	12.82	97	
2 D	10	.128	3.12	3.09	97	.0039
*3 D	20	.038	43.78	43.29		
1 E	16	.065	12.56	12.44	96	.0041
2 E	18	.048	24.34	24.07	91	.0035
1 F	8	.164†	2.02	2.00	88	.0037
1 G	8	.061†	2.11	2.09	93	.0042
2 G	6	.075†	1.37	1.35	94	.0030
3 G	18	.050	21.39	21.15	94	.0042
4 G	12	.10	12.69	12.55	95	.0047

* For one of the 25 conductors.

† Diameter is for one strand of the seven, and gauge number corresponds to area of copper in conductor.

Insulation Resistances.

METHODS.—The samples of wire furnished by the different manufacturers being short, we soon discovered that it would be impossible to measure the insulation of many of the wires by the ordinary method of sending a current through it and calculating the resistance from the deflection of the galvanometer. Therefore we used two methods, one or the other being adopted according as the insulation was high or low.

1. By arranging the circuit as shown in the diagram, Fig. 3. The galvanometer is standardized, and then, having obtained a certain deflection, using a known electromotive force, we have for the insulation of the piece, in ohms:

$$R = \frac{E_2\, d_1\, s_2}{E_1\, d_2\, s_1} r.$$

Where E_1 = electromotive force of one cell.

E_2 = electromotive force of the battery used in the test.

d_1 = deflection, using one cell, when the galvanometer is in series with a simple resistance r and is shunted (s_1 being the shunt ratio).

d_2 = deflection of the galvanometer when connections are made as in the figure.

s_1 was $\frac{1}{1000}$; r was 10,000 ohms.

By this method, we could measure with accuracy a resistance of 7,000 megohms, corresponding to about 25 megohms to the mile, the lengths of the wires being in the neighborhood of 20 ft., as given below. The constant of the galvanometer was $7 \times 10{,}000 \times 1{,}000 = 7 \times 10^7$.

2. For measuring higher resistances, we made use of the following method.

The battery consisted of 100 gravity cells, and the arrangement shown in the diagram, Fig. 4, was employed.

Here A is a plug key; B and C four-contact switches; D is a Webb discharge key, by Elliott; F is an Elliott $\frac{1}{4}$ microfarad condenser; G, a Thomson astatic galvanometer of 7,000 ohms resistance, by Elliott; E, earth connections; J, jars containing the wires; K, make circuit keys; r, resistance of 10,000 ohms.

The deflection due to charging the condenser with a single cell was first taken. Then the wire under observation was charged through the galvanometer to a potential E_1, by closing at A, b, c, and then making a momentary contact at D.

After a time t, the wire was discharged through the galvanometer, by unplugging A and closing at b, b^1 and c, and then making contact at D.

Let d_0 = deflection due to charging condenser with a single cell of E. M. F., E_0.

d_1 = deflection obtained in charging the wire to potential E_1.

d_2 = deflection obtained upon discharge, after t seconds, potential E_2.

C = capacity of the wire.

Then $$C = \frac{1}{8}\,(\text{mf}) \times \frac{E_0}{E_1} \times \frac{d_1}{d_0};\ \text{and}$$

$$R\ (\text{in megohms}) = \frac{t}{C \log_\varepsilon \frac{E_1}{E_2}} = \frac{t \times .4343}{C \log_{10} \frac{d_1}{d_2}}$$

The galvanometer and shunt were insulated upon layers of beeswax; the shelves upon which the battery cells stood were coated with paraffine; the keys were all additionally insulated by being dipped in paraffine or beeswax; the fine wires leading to the wires under test were supported by a glass rod, which had been dipped in paraffine.

The ends of all wires tested were first stripped for about an inch, the insulation being beveled off at this point, and were covered with a thick layer of paraffine or beeswax by dipping into the melted wax. Before taking an observation, the surface of the waxed ends was pared or removed, care being taken not to touch the wax with the fingers.

Our first observation each day was upon the insulation of our apparatus, which was tested in detail, and no further work was attempted until this insulation was perfect. These observations were repeated from time to time during the day.

ARRANGEMENT OF WIRES.—The wires to be tested were cut into carefully measured lengths, which were coiled up and placed in earthenware jars of about five gallons capacity. Before putting in any of the coils a copper plate, with a wire connected to it, was put in for an earth; then, after the jar had been half filled with the coils and the preparation, whose action upon the insulation we wished to study, a similar earth plate was put in and the filling continued, both ends of all wires being allowed to project several inches out of the jar and only one end of each projecting through its wax covering for connection.

At least one wire of each description was placed in each preparation and, in cases where we had been furnished with a sufficient length, several wires of the same maker were placed under each treatment.

Jar I. contained saturated sea brine.

Jar II. contained wet earth.

Jar III. contained wet earth and coal gas.

Jar IV. contained mortar.

In order to test the effect of heat a boiler was constructed about ten inches in diameter and about three feet high. Supported on the inside, above the level of the water, was a metal tube, around which were wrapped wires to be subjected to steam. The tube was in connection with the outer casing, and was about five inches in diameter. Around the outside, and supported by a flange to prevent the wires slipping, were wrapped lengths of other wires, whose behavior under dry heat was to be studied. The ends from both outside and inside groups of wires were brought up through close fitting holes in a heavy wooden top (to protect the ends from the steam and shield them from the heat), while the steam escaped from a glass pipe, terminating about fifteen inches higher up.

In order to test the action of weather, we covered a board with tinfoil, secured wires along it by tacking strips of cloth across them, and exposed them during summer and winter upon the roof of the building. The wires were also tested at very high temperatures.

A more complete description of each treatment will be found below.

[TO BE CONTINUED.]

Meeting of the Board of Electrical Control.

It will be remembered that in May last a misunderstanding arose between Mayor Hewitt and the other members of the Board. This resulted in the Mayor's refusing to attend any more of its meetings, which have since been held at its office, 1,218 Broadway.

Mayor Grant, however, on accepting office, pledged himself to put the wires underground, and decided that the future meetings of the Board should be held at his office. It was accordingly there that the Board met on Jan. 18, and judging from the number of representatives from leading electrical corporations who listened to, or took part, in the proceedings, the occasion was one of unusual interest and importance.

On Mr. Hess resigning as president, the thanks of the Board were tendered to him for his services, and Mayor Grant was elected president.

A communication was read from the custodian of the Sub-Treasury, asking for the removal of a pole of the Metropolitan Telephone and Telegraph Company, which overhangs the building. It appeared that the company had before been ordered to remove this pole, and it was decided again to direct it to do so.

A copy of the decision of Judge Lawrence in favor of the Board in the case of the United States Illuminating Company against the Board of Electrical Control, was ordered to be spread on the minutes. The annual report of the Engineer of the Board was then read.

The Brush Company applied for permission to transfer its wires from poles on the east side of Avenue A. from Essex to Twenty-third streets, to the poles of the Western Union Company on the west side of the avenue. Upon the expert stating that there were forty-one dead poles on the west side of Avenue A and thirty-one on the east side, with a gap between Ninth and Fourteenth streets, the Mayor expressed the opinion that the application appeared to be an attempt on the part of the company to close up the gap that exists in their lines by getting possession of new poles, and he wished to learn the policy of the Board with regard to the erection of new poles.

Commissioner Gibbens explained that the Board was disposed to make concessions to companies who were using the subways when completed, and permit them to erect poles in streets where no subways were laid. The Mayor was strongly against allowing new wires to be strung on existing poles, and, on motion, the application was denied. Among other applications which followed was one from the Harlem Electric Lighting Company, which wished to construct a line of poles on Third avenue, from Forty-second to Eighty-sixth street. Mr. Hess stated that this company had made application to put its wires on the poles of the Western Union Company, but had been refused permission to do so. Commissioner Gibbens did not think it was well to shape any particular policy in regard to granting these rights. Every application should stand on its own merits. It was not reasonable to suppose that the Board was there to prevent any company doing business, but it was there to restrict the undue increase of overhead wires, even as a temporary expedient. He moved and it was resolved that the applications be laid over for further consideration at the next meeting.

The Mayor presented to the meeting a letter he had received from the attorneys of the United States Illuminattng Company, and stated that as he wished all the companies to be treated alike, he had asked a representative of the company in question to be present, to see what the sense of the Board would be in the matter. The letter, which was then read, stated that although the Board claimed that it had provided a suitable and efficient subway in a certain part of the city, and had directed the United States Company to place its wires therein, ex-Mayor Hewitt had frequently expressed the opinion that the said subways were entirely insufficient for electric lighting purposes; that the questions upon which the company was at issue with the Board were embodied in certain suits which would shortly be called for trial; and that "no electric light companies have placed, or have been compelled to place, their wires in the so-called subways, save that the Brush Illuminating Company had experimentally laid about a mile of cable in the subway some months ago, but have never been able to get any circuit through, or to make use of the same, and their tests have shown that the electric current cannot be carried through the subway."

The company further asked that no proceedings should be taken pending the decision of the suits. The most striking part of the letter, however, was where it offered to lay an experimental cable in the subway forthwith for the purpose of testing the practicability of the system. Commissioner Gibbens said: "Before the Board takes action on this letter, I wish to point out several false statements, which merely require to be called attention to to be recognized as such."

"For an electric light company to attempt to bias the mind of a member of the Board by statements such as these is highly reprehensible." Commissioner Gibbens then said, and referred to the expert and engineer of the Board to prove, that the Brush Company is now supplying lights at a number of places from its cable. He went on to say that the other companies had been putting their wires underground, and all that would have been necessary to entitle the United States Company to like privileges with them was that it should take the same steps, *i. e.*, attempt to carry out the law. Its proposal to lay down a test cable was its first direct offer to comply with the orders of the Board.

Mr. Rothman, who represented the attorneys of the United States Company, assured the Board that so far as his firm was concerned, the letter had been written in perfect good faith, and he suggested that the question of immediately laying the test cable be referred to the expert of the Board and a representative of the United States Company.

The Mayor was in favor of granting the application of the company. Commissioner Hess said that he was so glad to see the change in the attitude of the company that he would agree to almost anything, and he moved that the company be given permission to lay an experimental cable, upon consultation with the expert of the Board. The motion was unanimously carried.

The report of the electrical expert, Dr. Wheeler, was then read. With regard to recent underground work he said: "The first arc lights operated by underground conductors in New York have been started by the Harlem Electric Light Company and are now running successfully. The conductors connecting these lights are Bishop's gutta percha covered cables such as could be found readily in the market, and are single conductor cables according to the recommendation of the Board. They are laid in the Johnstone conduits on 125th street from Third to Lexington avenues, and are connected with the station by overhead wires of the ordinary kind. The overhead wires are connected to the cables at the top of the lamp-post, and the cables are carried down the lamp-post, under the curbstone and into the conduit through an ordinary iron pipe set in the post. The house connections are made through iron pipes running from the conduit under the sidewalk and up the front of the building in an inconspicuous place. The tests of the underground cable and of the overhead connections showed very high insulation, and the whole is working very satisfactorily, and poles are down.

"The eight-conductor cable laid for the Brush Company on Broadway, from Fourteenth to Thirty-fifth streets, has been tested, and the insulation of the joints very much improved. This cable, which had an insulation of itself very much in excess of the standard required, was found to have a lower insulation when connected up, in consequence of slight moisture reaching the joints before they were covered up during the rainy weather. This has been overcome by simply warming and drying the joints, and now it has an insulation of 50 megohms for the entire length of one mile, and while the company having the matter in charge propose to carry the improvement still further, the cable is already in extremely good condition, and perfectly suitable for carrying high pressure currents. In fact such currents could now be put on the cable with perfect safety, even if it had only one-quarter of its present insulation, notwithstanding statements made by the press that it is a failure."

"Another passage of the report was as follows: "The subject of explosive illuminating and other gases entering the subways from the surrounding earth has received considerable attention, and a number of good plans for remedying the difficulty have been suggested. It is suggested to keep the air filling the conduits at a slight pressure in excess of the external pressure by means of small blowers applied at one or more points of the system. The purpose of this is to change the direction of the slow leakage of gas through the walls of the manholes. So that instead of gases gradually coming through from the surrounding earth the air will slowly escape from the manholes into the earth or else hold the gases in check. It is thought that a very slight pressure of perhaps a quarter of a pound to the square inch similar to the pressure of gas in the gas mains, which is inexpensive to maintain, will be sufficient for this purpose. When a manhole is opened for making connections, the circulation of the air through the connecting tubes to other manholes will be so slow that it will not seriously reduce the pressure of the system, particularly if all but one or two of the tubes are plugged.

"Another plan which has been suggested is to fill the entire system of subways with carbonic acid gas, the material which is used in portable fire extinguishers. This has the great advantage that it will effectively prevent the formation of explosive mixtures, will prevent the communication of fire, and will in fact extinguish any fire, as is well known."

The Board adjourned subject to the call of the Chair.

The Sprague Electric Road at Cleveland, O.

On the night of Jan. 9, there occurred in Cleveland what many people declared was the most severe wind storm that that city has ever experienced. This storm continued with great fury for eighteen hours, and according to the reports of the local United States Signal Service officer, its velocity for several hours during that period reached the enormous rate of 40 miles an hour, and for a time registered even *fifty* miles an hour. Every system of telegraph, telephone and electric light wires suffered very considerable damage, and the service of the companies owning these wires had to be suspended for some time. In spite of this destruction, the wires belonging to the electric railway, owing to the great care with which they had been erected, and their stability, remained intact, nor did the terrific storm interrupt the service of the Sprague cars in the least degree.

Following the tornado, upon Jan. 11 fell a very dense, fleecy, wet snow for several hours, which covered the tracks of the street railway to the depth of from ten inches to a foot. The first car over the line carried a small supply of salt, which was distributed over the track, and after this was done, no trouble whatever was experienced. All the morning, and throughout the storm, the cars on the horse railways in Cleveland were delayed and running behind the schedule time, but no car on the Sprague electric road was delayed. Throughout the greater part of the day, while the storm continued, the cars did double duty, by drawing a second car, both crowded full, without difficulty.

The citizens in Cleveland are enthusiastic over the success of the road, and President Everett has received a great many congratulations in regard to his electrical equipment. It is said that the management of the East Cleveland Railroad Company intend to extend their line before long, using the electric system.

Some New Thomson-Houston Electric Roads.

The DesMoines Broad Gauge Railway Company, which has been equipped with the Thomson-Houston Electric Railway system, has been in operation since Dec. 20, and most successfully too. The first trial trip made on this road was such a one as to convince the most unbelieving of the practicability of the electric railway. The car had a load of 87 passengers, and the rails were thickly covered with mud in many places, but these drawbacks had no effect upon the operation of the car, which mounted the grades and rounded the curves with an ease and precision which clearly showed that the apparatus was capable of doing the heaviest work which would be required. The total mileage is 7.5 miles, and eight cars will be operated. During the severe snowstorm in DesMoines, when about one foot of snow fell, the motor cars made their regular trips every fifteen minutes. The horse cars put on four horses, but could not run on time then, and the steam motor which runs out into the north end of the town got ditched, so that the electric cars were the only ones operating during the storm. This is certainly very flattering to the system. The receipts from four motor cars on this road are four times more than from five cars operated by horses.

The Third Ward Street Railway Company, Syracuse, N. Y., which is operating the Thomson-Houston system, has been somewhat delayed by difficulties connected with the track construction, but it is now in operation. It has eight cars and four miles of track.

The Riverside & Suburban Railway Company, Wichita, Kan., has operated successfully since starting, and has stood all the tests of bad weather and frozen, muddy streets, never having lost a single trip. The people of Wichita are enthusiastic over it, and are learning by experience the comfort and satisfaction which this service affords. The track is built of Johnston rails in the city limits, and the ordinary "T" rail is used outside. The power plant consists of two 40 h. p. generators. There are three cars in operation, each equipped with Thomson-Houston motors and lighted with electric lamps.

Three of the improved Thomson-Houston trucks have been in use for some time past on the Scranton Suburban Railway, and the manner in which they operate has been the occasion of much favorable comment. Each truck has two 15 h. p. motors. The first one was shipped early in August and was used under a large open car and frequently carried up the heaviest grades a load of 75 people and on several occasions more than 100 people. The truck was afterwards put

under a heavy Pullman car which weighs almost as much empty as an ordinary street car does when loaded, and its operation under this car was, it is said, equally as satisfactory. This road is one which has many curves and heavy grades, and the motors are called upon to do some very heavy work; but they proved themselves to be perfectly reliable and abundantly able in every way to supply the demands made upon them.

A Novel Proposition for City Lighting at Steubenville, O.

At a recent meeting of the Steubenville (O.) Council, the local electric light company, in a communication submitted the following proposition: To light three of the principal streets for a period of five years with arc lamps of 2,000 candle-power, each to be placed at street intersections, and to burn all night and every night for the sum of $1 for all arc lights from time of starting until Sept. 1, 1889, and for $2 from Sept. 1, 1889, until Sept. 1, 1890. After Sept. 1, 1890, until expiration of contract, the consideration to be $75 per annum for each arc light.

With regard to this the Steubenville *Gazette* says: The five-year contract made with the Steubenville Electric Light Company may be a good thing for the city, and it may not be. The bid is apparently very low, but it may be deceptive. The $1 for lighting three streets for one year and $2 for the next are certainly low rates for electric lighting, and no other city in the country has a cheaper rate, but for the other three years the contract is for $75 per light, and there is nothing to prevent Council from increasing the number of lights indefinitely, and the incentive will be the claim that it will cost nothing, for $1 for the whole thing is not worth considering at all, but on the third year the increased lights will cost something. However this may be, the Steubenville Gas Light and Coke Company, the only industry in the city that uses Steubenville coal, has an electric light plant almost completed, and we understand will be in shape to compete for electric lighting in two months. This competition will be sharp, and had the Council waited who knows but what the rate for electric lighting would have been very much lower? Under the circumstances it is the belief of citizens that Council has made a mistake in contracting for light right on the eve of competition. The Steubenville Gas Light and Coke Company has put in in the neighborhood of $10,000 in an electric plant, with a view of being in shape to compete for the city lighting, and it should have had an equal chance to bid on electric lighting with the Steubenville Electric Light and Power Company; then had the bid of the latter been lowest, there would be no one to criticise or complain outside of the company beaten. As it is, the apparent low bid may turn out to be a very high one.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
168-177 POTTER BUILDING, NEW YORK, Jan. 21, 1889.

Eddy Motors.—Willis & Hunter report continued activity in the demand for Eddy motors. Their orders on Wednesday last were for one 10 h. p., two 7½ and two 5.

Personal.—Mr. Lucas, of the Washington (Pa.) Carbon Company, was in town during the past week. He represents a new corporation in which some prominent electric light men are said to be interested. They are already prepared to take orders for carbons in any quantity.

Edson Recording Gauges.—The Brush Electric Light Company, of Buffalo, N. Y., have adopted the Edson pressure recording steam gauge, and the Edson speed recorders. Mr. Edson also reports sales to the Brush Company, of Detroit, and to several others nearer home, including the Citizens', of Brooklyn. Evidently electrical engineers and those in charge of lighting plants are realizing the value of such apparatus.

The Daft Street Car of the Sixth avenue road has 86 cells of the Gibson storage battery, with which equipment it ran on Jan. 4 a distance of 20 miles, on a stretch of 350 feet of track, making 300 stops and carrying a load of 6,000 pounds of pig iron. The Gibson cell has also been put on a car for New Orleans, where no overhead wires will be allowed for street car work. The cell is also being used for lighting in the Aldrich Court building.

The Electrical Accumulator Company, of 44 Broadway, are to put up 100 cells of their storage battery for lighting the ball room of Cornelius Vanderbilt's residence on Jan. 28, on the occasion of a big ball. The recent similar installation at Mr. Webb's, to which I referred in these notes, was a great success. The lamps were set around the cornice in the ball-room two feet apart, and a pink chintz silk curtain was dropped in front of each, forming a pretty frieze and yielding a light that, as Mrs. Ayer would say, was unsurpassed for improving the complexion. In the dining-room the lamps were placed at the top of the walls and covered with cut glass bulbs and opal shades. In this instance only 66 cells were used, with 60 volt 16 c. p. lamps in two series.

Lighting the Yacht "Ballymena."—The Gibson Storage Battery Company, of 775 Greenwich street, this city, are in receipt of the following from Gen. G. S. Brown: "In thus closing up the contract for work on my yacht 'Ballymena,' I take pleasure in testifying so far as I can judge from the few weeks experience with your batteries, to the convenience and satisfaction they have been, and from all I can see, I believe them to be the best storage battery on the market. The comfort and convenience of being able to store up electricity for several nights without running the dynamo other than for a few hours, appears to me to do away with the only real objection to electric lighting of yachts, and I should think that with your batteries it would come into very general use. You are quite at liberty to use my name, and refer any one desiring a personal inspection to my yacht." W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, 146 Franklin St. and 149 Congress St.
BOSTON, Jan. 21, 1889.

The Hartford Dynamic Switch, which you have illustrated and described, is being handled by Dickerman, Adams & Co., 620 Atlantic avenue, as New England agents.

Proposed Electric Railway.—It is reported that the Thomson-Houston Electric Company will be awarded, at an early day, the contract for the construction and the equipment of an electric street railway in the town of Hyde Park, Mass.

Eddy Electric Motors.—The N. E. agents of the Eddy Electric Manufacturing Company, Messrs. Dickerman, Adams & Co., Boston, have made the following installations recently: A 15 h. p motor in the Edward A. Green & Co. building, on Congress street, and a 10 h. p. motor in the Cook building, corner Congress and Franklin streets. Both motors are running elevators and giving thorough satisfaction.

The Electric Gas Lighting Company, of Boston, has just issued its "List F, January, 1889," which constitutes a catalogue and price-list of over 60 pages. It is beautifully printed, and contains a great number of descriptions and illustrations of its well-known gas lighting apparatus, and of electrical goods in general. The goods are divided into two classes. An announcement is made that agents are wanted in every city and large town to make a business of fitting up dwellings, offices, etc,. with this apparatus, now so well known and popular.

Increase in Electric Lights.—The Brookline (Mass.) Gas Light Company is enlarging the lighting capacity of its incandescent department. Dr. Robert Amory, the president of the company, deserves great credit in placing the joint illuminating (gas and electric light) enterprise, over which he presides, on the solid financial basis it occupies and for the prosperous outlook it has for the future. The electric light systems used by the company—arc and incandescent—are those of the Thomson-Houston Electric Company. A new 100 h. p. engine of the McIntosh, Seymour & Co. make has just been added to the equipment of the steam plant by the New England agents of that firm—Messrs. Grant, Pierson & Co., of Boston.

Personals.—Mr. M. W. Baird, of the Eddy Electric Manufacturing Company, Windsor, Conn., has returned from an extended Western trip and is sojourning for a few days at the "Hub."

Mr. David Chalmers, who has been identified with several important electrical enterprises during the past five years, and is at present a traveling representative of the Empire City Electric Company, of New York, has been interviewing the electrical supply people of Boston during the past week.

Mr. Frank C. Mason, of Brooklyn, N. Y., the superintendent of the Police Telegraph Bureau (see THE ELECTRICAL WORLD, June 23) of the city named, was in Boston last week the guest of Mr. John C. Wilson, president of the Municipal Signal Company. Mr. Mason enjoyed his visit to the Hub very much. Among the numerous places of interest visited by him was the Boston Electric Club.

Baxter Electric Motors.—The following installations of Baxter motors have been made in New Engand recently by Mr. Frank Ridlon, manager of the Northeastern department of the Baxter Electric Manufacturing and Motor Company: One 6 h. p. at the Tremont & Suffolk Mills, Lowell, Mass.; two 10 h. p. for Lamson Store Service Company, Lowell, Mass.; one 10 h. p. for Walter Co. burn, Lowell, Mass.; one 10 h. p. for Jeremiah Clark, Lowell, Mass.; one 6 h. p. at Town Hall, Brookline, Mass.; one 6 h. p. (constant potential), for J. H. Long, Boston, Mass.; one ½ h. p. (constant potential) at the Standard Clothing Company's store, Boston; one 2 h. p. for Edward S. Clark, Boston; one 1 h. p. and two ½ h. p. for the Phœnix Electric Light Company, Greenwich, R. I.; an increase in motors for the Waterville (Me.) Electric Light Company; one 2 h. p. (constant potential) for the Consolidated Electric Light Company, Portland, Me.; one ½ h. p. for Sargent Brothers, Boston; one 2 h. p. for Miller & Co., Boston.

The Sprague Electric Road at Boston.—The Sprague Electric Railway, which extends from the centre of the city at Park Square to Brookline, and is a part of the West End Electric Railway, is now in practical operation, and is carrying a large number of passengers. The cars run easily and are under complete and perfect control, and respond readily in changing the speed to the different movements of the electric switch on the front platform moved by the operator. These operators are not skilled electricians, but in most part street-car drivers, who have learned the method of operating the electric car after a few hours practice, and who expressed the opinion universally that it is far easier and more pleasant work than driving horses. The road has been already visited by a large number of street railway men from the neighborhood, who have come to investigate, and who have appeared to be very much pleased with the neatness and unobtrusiveness of the over-head system, and general look of stability and reliability of the entire road.

The Electric Exchange.—There was a large gathering of electrical people at the regular quarterly meeting of the New England Electric Exchange. Ex-Mayor Hugh O'Brien was one of the auditors. P. H. Alexander, President of the Exchange, occupied the chair. A number of representatives of electric light and insurance companies were present. The feature of the meeting was an important paper on the "Relations Between the Electric Light and Insurance Interests," read by Colonel E. H. Hewins, of the New England Western Electric Light Company. The subject of the paper is just now attracting a great deal of attention. President Alexander in introducing the business of the meeting, suggested a permanent office in Boston for the New England Exchange, and spoke of the increase of membership during the year. The office should be a medium of information for all parties concerned in the electric light and power business. Referring to the applications for licenses which had been made, he said that 159 had been examined and 126 granted. Speaking of the objection to electric wires and the report that insurance rates were to be raised on account of the wires, they asked for a full discussion of the subject by electric light and insurance men. To this end Colonel Hewins had kindly arranged to read a paper on the subject, so that practical men on both sides could express their opinions pro and con. Following the President's opening remarks routine business was transacted—in which Messrs. Andrew Robeson and J. Y. Bradbury were elected directors, to fill vacancies caused by resignation—and Col. E. H. Hewins was introduced. He only desired to bring the subject before the meeting, and therefore his address was very brief. He spoke of the organization of the Exchange, and drew the attention of the gentlemen present particularly to that portion of the objects of the association which referred to the importance of harmonious relations between electric companies and insurance interests. Discussion on the paper followed.

The Armington & Sims Company.—The Providence *Evening Bulletin* in its yearly review says: The Armington & Sims Engine Company reports an increase of 75 per cent. in the volume of its business as compared with 1887. This enterprising and flourishing concern moved its establishment to the Paine & Sackett mill estate on Eagle street a year ago, the business having grown beyond the capacity of the old location on High street, and already has been compelled to increase the capacity of the new plant by the erection of a new building covering 10,000 feet of ground, to provide room for additional heavy tools for making special parts of the engines and to make a general increase of equipments. The product has been one engine a day, averaging 100 horse-power each, and throughout the year the company has been from 90 to 100 engines behind in delivery of orders. It was intended, when the Eagle street establishment was secured, to extend the business by the manufacture of large engines for manufacturing purposes, but the concern has been so driven with orders for engines to supply power for electric lighting that it has been impossible to make anything but engines for this branch of work, and many orders for mill engines, received without solicitation, have been rejected. Several engines of this class have been turned out, and the management feel assured of a good opportunity for profitable enlargement of the business by future efforts to supply the demand. The average size of the engines has been steadily increasing during this year. This establishment has large government contracts for engines to supply power in the Ordnance Department at the Washington navy yard, and for furnishing power to light new and old cruisers by electricity, every vessel in the navy that is so lighted having an Armington & Sims engine for the purpose. There are double engines of high speed and to couple directly to the dynamos. Twenty engines, small in size, but to furnish 450 horse-power at 150 pounds steam pressure, are now being turned out for the Edison central lighting station in Philadelphia, and two large stations in New York City are being provided with engines. A large foreign trade has been secured, and during the year orders for engines for electric lighting in Milan, Italy, have been filled. The Italian parties were recommended by Armington & Sims to procure their engines from the factory in Leeds, England, but they insisted on securing them from the Providence establishment, for they believed they got better-made engines, and Armington & Sims found they could lay down engines in Milan cheaper than they could be placed there by the English makers of the Armington & Sims engines. The working force has been increased, and now numbers over 200 men. They have worked three nights a week till 10 o'clock last month, when night work was abandoned because of the wear and tear on the men, the firm considering ten hours a day enough and deciding it more economical to increase the number of tools to do the work required. W. I. B.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
31 City Trust Building, Philadelphia, Pa., Jan. 19, 1889.

Mr. David Brooks is recovering from a slight indisposition. He was unable to attend to his duties several days last week.

The Underground System.—An ordinance granting the Penn Electric Light Company a two years' extension of time for the construction of the conduit system was favorably recommended at a fully attended meeting of the electrical committee last week. The president of the company stated that 55,700 feet, or over ten miles, of conduits had been laid up to the present time.

The Telegraphers' Aid Society held its annual meeting on Monday night and elected the following officers: President, J. C. Berrett; vice-president, W. D. Schuster; recording secretary, W. E. Vanarsdale; financial secretary, A. W. Ford; treasurer, H. W. Hetzel. J. E. Janney, the retiring president, was presented with a handsomely engraved water-pitcher in recognition of his services as head of the organization.

The Thackara Manufacturing Company makers of electroliers, etc., are kept busy by the growing demand for domestic electric lighting. About one year ago they did little or no wiring of private houses, but this work has so increased with them that it now occupies fully 50 per cent. of their business. The magnificent Union League building on Broad street was one of their first contracts, and the work was so ably and thoroughly done that it proved the nucleus of a very remunerative trade. They are crowded with new contracts.

Electric Railways at Allentown, Pa.—It is stated that the syndicate of capitalists who have purchased the Allentown Passenger Railroad franchise will construct an electric railway from that city to Bethlehem. Superintendent Bonnell says that arrangements to that effect are under way. This would bring the Rittersville Driving Park, between Allentown and Bethlehem, into prominence. The park has an excellent half-mile track and would make a suitable base-ball site. It is also stated that a similar line from Allentown to Catasauqua will be constructed.

Electric Lights and Business Methods.—The metal merchants doing business in the northern and northeastern sections of this city are alive to the advantages of lighting their stores with electricity. Two companies have been formed, styled respectively the Frankfort Avenue Merchants' Electric Light Company and the Merchants' Electric Light Company of North Front Street. Recently these companies applied to City Council for authority to place their wires in certain streets in their vicinity. The petitions were referred, but there is no question of the permission being granted.

Electric Lights on Vessels.—Several new tugboats and merchant craft now building in this city are being fitted throughout with electric lights of all kinds. The officers' rooms, the mess-rooms, the galley and even the much despised fo'castle will reflect the softglow of the incandescent lamps, and the usually dismal "hold" will be lighted when the occasion requires. The Ocean Line of steamers, plying between this port, Savannah, Boston and New York, has search lights of high candle power on all its vessels, enabling them to ascend the meandering rivers of the South with comparative safety. A search light on the tug "Argus" aided materially in raising the sunken steamer "Montana," in Chesapeake Bay, last week, as inability to work at night would have added largely to the already heavy loss.

The Electric Car Company of America is practically still out of the market, according to its president, Mr. W. W. Wharton, Jr. Commenting on the situation, Mr. Wharton said last week: "We are perfectly satisfied with our car, which is a mechanical success. The great disadvantage to its commercial advancement is the first cost, and we are striving to reduce that to a reasonable basis. And I think we shall be successful in this, for we have already made some improvements that will cheapen the construction and we hope soon to be able to knock off at least 33⅓ per cent. of the present cost. Until we do that, we will not contract to furnish any cars, although we were compelled recently to send two to California. We are also making experiments to improve the motive power. We are trying a new type of accumulator and are making improvements in our motor. On the whole the outlook is very good." E. F. C.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
44 Lakeside Building, Chicago, Jan. 19, 1889.

Personal.—Messrs. C. F. Annett, president of the Rocky Mountain Telephone Company, and a resident of Salt Lake City, Utah, and C. B. Hopkins, of Colfax, W. T., were in the city a few days this week.

Injunction by an Electric Service Company.—The Chicago Electric Service Company has secured from Judge Horton an injunction restricting South Town Collector Bass from collecting a tax on its capital. The company claims it is organized for purely manufacturing purposes.

The Quincy Plating Company.—The Secretary of State at Springfield issued this week incorporation license to the Quincy Plating and Mfg. Co., at Quincy; the capital stock being $3,000. The incorporators are S. P. Bartlett, A. P. Fanna and Geo. W. Ascough. The company will do a plating (electro) and general manufacturing business.

Fixing Telephone Rates.—A special from Columbus, O., dated Jan. 10, says that the Legislature tackled the telephone that

day, and the house passed the Clark bill fixing the rental of telephones at $3 per month, and $2.50 per month where more than one instrument is used. The local telephone people say that they will withdraw their instruments, and close the exchange if the bill is passed by the Senate.

The Central Electric Company.—Mr. Fred Low, traveling salesman of the Central Electric Company, has just returned from a prosperous trip, and reports having sold within one week some 28 miles of the large sizes of Candee wire. The company report a brisk demand for general electrical goods, and the prospects are most excellent for future trade. They have just begun the manufacture of locust pins, which wood is claimed to be superior to anything else in the market for durability.

The Western Electric Company.—I learn from the Western Electric Company that every department in their extensive factory is being taxed to its full capacity to keep up with orders. In all departments the outlook for trade for the coming year is very bright, and especially in the arc light branch the outlook is better than ever in the history of the company. The company have now on their books orders aggregating some 700 arc lights, which they will commence turning out soon. All the additional room made by the company's new building is entirely occupied, and the machinery is all in place.

Wants to String Wires.—The Chicago Telephone Company have asked the Commissioner of Public Works for permission to string wires overhead across Jefferson street, between Madison and Monroe, across Madison between Jefferson and Clinton, Clinton between Washington and Madison, Robey between Monroe and Madison, Adams, Quincy, and Jackson between Market and Franklid, Dearborn between Randolph and Lake, and across Fifth avenue between Quincy and Jackton. City Electrician Barrett is at present in the East, and the petitions were not acted upon, as the Commissioner thought best to await his return. Judge Green will in the meantime examine them.

Electricity Explained by Edison.—According to the Pittsburgh *Times*, a gentleman who thought he knew a thing or two about electricity was doing his best to convince Edison that he did, and advanced a theory about how electricity was produced. "O fudge," said Edison. "Do you know how electricity is produced? Why, by friction, of course. It flies off a wheel as it goes around. What makes it fly off? Why, the resistance of the air. All the electricity in the air is caused by friction produced by the atmosphere as the earth turns round. When you get higher up there is no electricity, because there is no friction." It looks as though Edison had been "roasting" the gentleman.

Kearney, Nebraska.—I clip the following from the Kearney (Neb.) *Daily Hub*, date of Jan. 5: "Negotiations have been carried on for some time past, and the contract has been closed, for the Western Engineering Company, of Lincoln, Nebraska, to remove to Kearney. The capital stock of the company has been increased to $100,000, and stock all taken. Thus one after another of the departments connected with the Geo. W. Frank Improvement Company are being filled. The Western Engineering Company put the electric plant in this city, and has many contracts throughout our own and adjoining States for other work. It will be a corporation of a high order, employing in its various divisions many hands. The fact is that Kearney is to become the electric centre of the West."

In the City Council.—At the Council meeting last Monday night Alderman Dixon presented the following resolution, which was unanimusly adopted.

"*Resolved*, That the law department prepare bills granting to the cities of this State the power to tax, license, regulate and fix prices to be charged for gas, telephones, electric lights and all others pursuing like occupations: also giving the cities power to tax foreign insurance companies 2 per cent. on their gross earnings, and also that cities shall have the power to take possession of and operate street railroad companies in case of failure to furnish transportation by reasons of strikes and also excepting gas and electric lighting from the 2 per cent. limitation on taxation for corporation purposes." The formal acceptance by the Chicago Telephone Company of the ordinance approved at the previous meeting of the Council was read.

A Singular Accident.—A very unusual accident occurred in the basement of Wilde's clothing house, Friday of last week, while the engineer was engaged in repairing a ten-light dynamo. The commutator had worn out, and a new one was attached in position and the power thrown on. The engineer was in the act of adjusting the brushes when the slate of the commutator flew to pieces, the sections being hurled in every direction. A piece of slate struck the engineer, making a gash on the left cheek. An examination disclosed the fact that there was no flaw in the plate which served as an insulator between the armature and commutator. The dynamo was speeded at 1,300 revolutions per minute, and the slate parted under the centrifugal strain. The accident was one almost unprecedented in the history of electric lighting, and is not likely to be repeated. The accident is thought to have occurred by the "running away" of the engine.

Telegraphers Ordered to Quit the Union.—A special from Clinton, Ia,, dated Jan. 12, says that the order has gone forth on that division of the Chicago & Northwestern that all operators of the Telegraphers' Brotherhood must resign from that organization or quit the employ of the Northwestern. There are a large number of the Brotherhood. What they will do is not known, as the order is a surprise to them. There are two organizations of telegraph operators—the Order of Railroad Telegraphers and the Order of Commercial Telegraphers. None of the train dispatchers on the Chicago & Northwestern road in this city belong to either body. The only association of the kind that numbers among its members train dispatchers of this road is the Order of Train Dispatchers. The company, however, is so favorably disposed toward this institution that at a convention of the members some three years ago a special car was placed at the disposal of the Northwestern train dispatchers to convey them to the convention at St. Paul. No prohibitory order of any description has been received at either Galena or Milwaukee train dispatchers' office.

A New Motor.—The following is from the San Francisco *Examiner*: "John Paitsch, a mechanic, who recently moved from San Francisco to Oakland, has invented a machine for utilizing electricity or some other force, which he will not say much about. An *Examiner* reporter viewed the machine yesterday in company with a civil engineer, and its power surpassed that of any machine ever seen by any of the company. The box in which the machine was inclosed was less than four feet long and half that width. The bed of the machine seemed to be simply a hollow box with a small shaft coming through one end, to which was attached a pulley. By touching a little lever at one end, the pulley began to revolve with great rapidity. A belt was attached to it and it turned an emery wheel so fast that an inch iron bar held in the hands of the reporter was soon ground down half an inch and was rapidly being eaten away when it grew so hot that it could be held no longer. Other experiments showing an equally great power were given. In speaking of the machine Mr. Paitsch said: 'I first conceived the idea while a student in Bavaria, and I completed the machine recently. I worked on it while at the Baldwin Locomotive Works, Philadelphia, but I am not ready to make public the secret.'"

New Thomson-Houston Installations.—The western department of the Thomson-Houston Company report the sale during the week of the following plants: A small arc light plant to Longley, Low & Alexander for their store on Monroe street, Chicago; 500 alternating incandescent lights to the Alliance (O.) Street Railway Company; 500 alternating incandescent lights and 50 arc to Messrs. Sleeper, Posten & McGill, of Nelsonville; 35 arc and 1,200 incandescent alternating lights to increase the plant of F. D. Wight, Trinidad, Colo.; 400 incandescent lights to the Cleveland Rubber Works, of Cleveland, Ohio, for lighting their factory; 20 arc lights to the city of St. Louis for lighting the water-works station; 600 alternating incandescent to the Reno (Nev.) Electric Light Company; 20 arc lights to Armour & Co., of Pewaukee, Wis., for lighting their ice house at that place; 50 arc lights for increasing the plant of the Badger Electric Illuminating Company, Milwaukee, Wis.; 150 arc lights to the Chicago Sash, Door and Blind Company for lighting their works. In its street railway department the company report having closed a contract with the Cincinnati (O.) Street Railway Company, of which Mr. John Kilgour is president, so well known in street railway circles, for an electric street railway, overhead system, 28,000 feet of single track, over 5 miles, and to be equipped with 8 cars, requiring three 100 h. p. generators. The Council Bluffs (Ia.) road is also putting in one 80 h. p. generator for increasing the capacity of the plant. E. L. P.

ENGLISH NOTES.

LONDON, JAN. 2, 1889.

Submarine Telegraph Extensions.—The Telegraph Construction Company's steamer "Seine" has just left London with the new cable of the Eastern Extension Company on board. This cable, which is over 1,000 miles in length, will be the third which this company has laid to connect Australia with Europe. The triplication of our telegraphic communications with Australia will soon be followed by the duplication of the cables to the Cape. One cable already stretches along the east coast, and before long another will run to the Cape along the west coast of the "Dark Continent." This cable is being made in two portions, of 700 and 1,500 miles respectively, the first by the Silvertown Company and the latter by the Telegraph Construction Company.

The "Viscountess Bury."—A large electric launch, the "Viscountess Bury," built to the order of Messrs. Immisch & Co., and lately illustrated in your columns, was launched last week at Hampdon. The boat measures 65 feet in length by 10 feet beam, with a mean draught of 22 inches. It is intended to carry eighty passengers and is propelled by twin screws driven by two 7½ h. p. Immisch motors, each of which is supplied with current from 200 accumulators. The "Viscountess Bury" is one of a small fleet of electric launches which Messrs. Immisch & Co. will have on the Thames next summer, the recharging being effected from any one of a chain of charging stations, which are now in course of construction all along the river.

A Striking Testimony to the Safety of Overhead Wires.—Some ten days ago a firm of solicitors in the neighborhood of Oxford street had their telephone apparatus burnt out by a "cross" with an electric light lead, and straightway wrote an alarmist letter to the *Standard*, headed "A New Danger," and containing the most dismal vaticinations. Considering that the little damage that was actually done was entirely confined to the United Telephone Company's property, this indignant epistle may be considered as one more instance of the "much ado about nothing," which is always adopted in this country with regard to electrical mishaps of all kinds. The apparently unprecedented character of this mishap is, I opine, a striking testimony to the comparative safety of our miles of overhead wires rather than a cause for alarm and indignant protest.

The Post-Office Land Line Wire.—In a short article which appeared lately in the *Electrician* some interesting facts are stated with regard to the iron wire which is now obtained by our Postal Telegraph Department. The wire is of two qualities, viz., low resistance and high resistance wire. The low resistance wire has a mean resistance of 11.2 ohms per mile at 60 degrees F., for the standard gauge of 171 mm., and is used for all circuits over 200 miles in length. The high resistance wire of the same gauge has a mean resistance of 12.7 ohms per mile, and is employed on small circuits. The tensile qualities of both wires are the same, and are somewhat higher than is usually the case. It appears that commercial iron may now be obtained having a conductivity of 98.44 per cent. of pure iron. Owing to its high price, copper, which was beginning to be used rather extensively for the post-office lines, is to all intents and purposes discarded.

A Wattmeter for Alternating Currents.—MM. Blondlot & Curie have devised a wattmeter, which promises to be of great use in the case of alternating currents. The instrument is an electrometer, in which the two opposite halves of the aluminum needle are insulated from one another. There are two pairs of semi-circular "quadrants," one above and one below the needle, and when used as a wattmeter the upper and lower plates on the same side are connected together and are then placed in connection with the ends of the conductor, in which the expenditure of power is to be measured. The two halves of the needle are connected to the ends of a non-inductive resistance, which must be placed in series with the other conductor. Although a reliable wattmeter is not of much importance in connection with continuous currents, it may prove of great use in many alternate-current investigations. Professor Ayrton is reported to have discovered that quadrant electrometers are subject to a certain aberration. It is to be hoped this defect has been got over in the present case.

The London Electric Supply Corporation.—The last week of the old year witnessed the meetings of our two largest metropolitan electric supply companies, the London Electric Supply Corporation and the Metropolitan Electric Supply Company. In both cases the meetings were called together to transact a little formal business and to hear what progress had been made. The London Electric Supply Corporation has decided to increase its capital by £250,000, in order to be in a position to extend the Deptford Station, as the demand for light increases. In this connection the chairman remarked that if the company had 150,000 lights ready now, they could place them in the course of the week. In reviewing the position of the company, Lord Crawford referred to a very conclusive experiment which had lately been shown to some representatives of the Board of Trade, with a view of impressing them with the comparative safety of high tension current mains, when put up with sufficient care and when insulated with good material. One end of a 2,500 volt lead was well earthed, and it was shown that no perceptible shock occurred when the experimenter grasped the other lead while standing on damp soil. As the lead which was touched was one which had been through over three years of London smoke and fog, the test was of a very practical character. The chairman also gave a few details with regard to what was being done at Deptford. Two 25,000 light machines are to be at work almost directly, and these will be supplemented later on by two 100,000 lighters. The remark that at Deptford they did not intend to have to run everything in order to meet the the demand, was hardly necessary after this announcement. Lord Crawford's interesting survey concluded with a somewhat pathetic complaint about the delays, demands and opposition encountered by the company in its dealings with the London local authorities. This opposition on the part of the local authorities is, however, only to be expected, when the far-spreading operations of the company are considered, not to mention the rumors of the enormous tension it proposes to employ.

The Metropolitan Electric Supply Company.—The meeting of the Metropolitan Electric Supply Company, which took place on the same day as that of its rival, was of an equally encouraging nature. Real progress was reported, and every one was sanguine as to the future. Perhaps the most pleasant part of the chairman's speech was that announcing that by an alteration in the terms of purchase, the shareholders had secured the Whitehall installation for 50 per cent. less than the original price agreed to. Instead of £79,000 only £40,000 was to be paid. The chairman (Sir John Pender), apparently thought the sum too low, but of course did not quarrel with it on that account, and only sought to explain the difference between the sum originally agreed to, and that settled by the arbitrators, as arising probably from the fact that they had omitted from their calculations "those elements of future value which the venders not unreasonably considered so important." It is encouraging to note that the Whitehall station, which has a 10,000 light capacity, has had that amount already taken up, although it was only opened at the beginning of October. Among its customers are the Avenue Theatre, the Hotel Victoria, the Grand Hotel and St. Martin's Church The chairman anticipates a yearly profit of something like 20 per cent. on this station. Another piece of good news to the shareholders was the announcement that the company had secured a monopoly of the lighting of the new Salisbury estate, situated in the Strand, for the ground of which alone a sum of £200,000 has recently been paid. Reference was also made to the 50,000 light Westinghouse station in Sardinia street, and to the proposed 150,000 light station on Waterloo Bridge wharf. These and the several other stations which are projected, completely exonerate the directors of the Metropolitan Electric Supply Company from any accusation of idleness, and to which Sir John Pender repeatedly refused to plead guilty.

THE TELEGRAPH.

New York Schools.—The Board of Education is to spend $10,000 on fire alarm telegraphs for the schools under its charge.

Hyde Park, Ill.—The Hyde Park District Telegraph and Electric Company has been formed by J. Crape, C. H. Caldwell, J. Lake and F. M. Winters, with a capital stock of $10,000.

Western Union in Chicago.—A special dispatch from Chicago of Jan. 18 says: A number of official changes in the Western Union Telegraph service took place to-day. W. J. Lloyd, formerly Chief Operator of Chicago office, was promoted to the position of Assistant Superintendent of the First District. W. B. Holligan, Manager of the Board of Trade office, was made Chief Operator. D. S. Anderson becomes Manager of the Board of Trade office, and John F. Stevely, Assistant Chief Operator.

The Snow-Alley Case.—A special dispatch from Dedham, Mass., of Jan. 14, says: "The famous Snow-Alley case came up for trial for the sixth time in the superior civil court this morning, Judge Aldrich presiding. The particulars of the previous trials were reported in full and in the brief. The suit is an action of tort brought by Chester Snow of Barnstable County against Hon. John B. Alley, of Lynn, to recover 100 Postal Telegraph bonds, the par value of which was $1,000 each, and which Mr. Snow claims Mr. Alley became possessor of through fraudulent means. Col. Ingersoll, who got the other verdicts set aside, is still counsel for Mr. Alley." The case was decided in favor of Mr. Snow.

South American Cables.—A special dispatch from Coatzacoalcoas, Mexico, of January 18, says: The steamer "Faraday," owned by Siemens Brothers & Co., of London, arrived off here this morning. She has on board more than 900 miles of the most improved heavy type cable, which she will immediately proceed to lay between here and Galveston, Texas, for the Mexican and Central and South American telegraph companies. When laid it will duplicate the gulf system of these two companies, providing increased facilities and insuring most rapid telegraphic communication by the American route, via Galveston, with Valparaiso, Chili, Buenos Ayres, Argentine, and all other important places in South America.

THE TELEPHONE.

The Telephone in Austria.—There are 3,305 telephone subscribers in Austria, who send 4,500,000 calls. Vienna has 894 subscribers at a rate of about $40 a year.

Telephone Life Saving Service.—A government telephone expert is looking over the Cape Cod coast, making estimates relative to the establishment of telephone connections between stations of the United States life saving service.

A Telephone Ear.—According to the New York *Tribune*, a member of the Bellevue Hospital faculty has been consulted by a young woman, a telephone operator, one of whose ears had been atrophied by the pressure of the telephone receiver strap.

German Statistics.—Germany in 1888 had 174 towns with telephone exchanges, 31,325 subscribers' stations, 5,329 kilometres of telephone line and 47,865 kilometres of telephone wire. Berlin and its suburbs has no fewer than 8,981 subscribers; Hamburg has 3,669.

Public Telephony.—The Metropolitan Telephone Company, of New York, have been hunting for subscribers who charge a small fee for the casual use of their telephones, as a matter of income. It is said that saloon keepers are the chief offenders in this respect, charging 10 cents.

A Telephone Musicale was given last week at Fairfield, Conn., by Mr. and Mrs. E. Harral. Invitations were issued to residents in Bridgeport, four miles distant. Those invited there remained at home and listened to the music performed at Fairfield. The affair was very successful.

The International Bell Company.—The annual report to Albany of the International Bell Telephone Company is as follows: Capital, $1,700,000; assets, consisting of exchanges in Europe and shares of stock in various countries in Europe, valued $1,250,000; no assets in the United States. Debts over capital include bonds of the company at 6 per cent., due Nov. 1, 1893, $238,000; liabilities on shares in European countries unknown.

Telephone Litigation.—A special dispatch from Boston of Jan. 19 says: "It has been rumored that the telephone controversy has been simplified by the combining of the Bell and Drawbaugh interests, and one of the leading attorneys connected with the Drawbaugh side, Parker C. Chandler, was asked with reference to the

truth of the report. He stated that no combination had been made or would be made, that each side seemed satisfied with its position; and while it might take years to bring about final results, every one was in shape for a long contest in the courts and Patent Office. He had no doubt that the government would win in its suit against the Bell Company, and that this suit would be concluded within a year and a final decision reached."

The Telephone in a Divorce Case.—A special dispatch from New Haven, Conn., in regard to a divorce case there, says: One of the facts brought out in the discussion was that Jonathan Ingersoll, the co-respondent, was in the habit of talking over a telephone with Mrs. Trowbridge. Mr. Trowbridge began to get suspicious, for whenever he telephoned from his office to his house he found it very difficult to make connection, as the wire was invariably in use. Under the direction of his lawyer consent was obtained from the proper authorities, and the wire was tapped, and competent persons employed to write down what passed over the wire. Then he found out what was going on. They made their engagements unsuspectingly, and Mr. Trowbridge had a stenographer to take down their felicitations.

Fining "Central."—A special dispatch of Jan. 12 from Waterbury, Conn.: "E. A. Saunders, of Naugatuck, wished a few days ago to call a doctor over the telephone. The operator at the central office here said, after trying, that the doctor would not answer. Later Mr. Saunders tried again and heard the operator say: 'He is after the doctor. Let the —— fool ring.' Once more he tried, remarking that he had been ringing for half an hour. The retort was: 'You're a liar.' Mr. Saunders then brought suit against the Southern New England Telephone Company for neglect of duty and abusive language. Operator Quinland denied having used such language, but Justice Gibbons to-day found the company guilty, and imposed a fine of $100 and costs. An appeal was taken. The company is wealthy, has a monopoly, and its hundreds of subscribers are watching the case with interest."

A Queer Claim.—The President has returned to the House of Representatives without his approval a bill to pay $48 to Michael Pigott, Postmaster at Quincy, Ill., this being the amount paid by him for the use of the telephone for the office for the year ended June 30, 1873. The President says that there is, evidently, a mistake in the date at which the telephone was used, as Pigott did not become Postmaster until 1881, but that, assuming that it is sought to reimburse him for money paid for the use of a telephone for the fiscal year 1883, it appears that the use of a telephone during that time was wholly unauthorized by the Post Office Department. The President says: "The multitude of claims of the same kind which the legislation proposed would breed and encourage, and the absolute necessity in the interest of good administration of limiting all public officers to authorized expenditures, constrains me to withhold my approval from this bill."

THE ELECTRIC LIGHT.

Ashland, Mo., has an electric light company.

Wilkinsburg, Pa., and Edgewood are to have arc lights.

Oneida, N. Y., is to vote this week on spending $3,000 for electric lighting.

Huntington, W. Va., will soon have a plant, it is said, of the Brush system.

Topeka, Kan.—Oil is to be used for fuel in generating steam for electric lighting.

Easton, Pa.—The city is running its 66 arc lights, it is said, at an annual cost of $64.72.

Lynn, Mass.—The Lynn Gas and Electric Light Company has a new contract at 46 cents per night.

Rome, Ga.—The Crown Electric Light Company is to put in an incandescent plant, as lately proposed.

Derby, Conn.—The Derby Gas Company seeks enlarged powers so as to do a general electrical business.

Baltimore, Md.—The city of Baltimore in 1888 burned 584 arcs and 32 incandescents, at a cost of $103,400.

Fredericktown, O., will probably have an electric light plant put in by Mr. P. B. Chase, of Mt. Vernon.

Jacksonville, Fla.—The Jacksonville Electric Light Company will have about twice its former capacity.

Ashland, O , is desirous of having the electric light, and particulars may be sent to Mr. F. D. Johnson.

Charlotte, N. C.—The D. A. Tompkins Company has asked for permission to erect lines for electric lighting.

Birmingham, Ala.—The Edison Electric Light Company will put in additional arc and incandescent apparatus.

San Francisco, Cal.—The Palace Hotel will put in a 1,000-light incandescent plant of the Fort Wayne Jenney make.

The Chico, Cal., Gas Company will put an electric light and power plant for general purposes in the old water-works building.

Rushville, Ind., has closed a contract with the Fort Wayne Jenney Company for the incandescent light on its streets for three years.

The Morris Machine Works, of Baldwinsville, N. Y., are in the market to buy a ten-light arc plant, and will be glad to receive bids.

Revere, Mass., has voted to supplant kerosene oil by electricity, and has under consideration a proposition from the North Shore Electric Light Company.

Leavenworth, Kan.—The Leavenworth Electric Light and Power Company has been organized with a capital stock of $100,000. The majority of the stock is held in the east.

Milwaukee, Wis.—The Western Electric Light Company of Milwaukee has been incorporated by H. C, Payne, F. J. Day and W. Plankinton with a capital stock of $100,000.

Cincinnati, O.—The first Cincinnati Edison Company has been granted the usual rights, on paying to the city one-half of one per cent. of its gross receipts and furnishing a bond in $50,000 to comply with the city ordinances.

Dyersburg, Tenn.—The Electrical Accumulator Lighting and Power Company, of St. Louis, have just closed a contract for a central station to illuminate the city of Dyersburg, Tenn., by the storage battery system, using "E. A." cells.

Birmingham, Ala.—The Merchants' Electric Light and Power Company has been formed with a capital stock of $25,000. The incorporators are G. C. Kelly, A. W. Fuller and R. Rochester. It is said that the Westinghouse system will be used.

Albany, Ore., prides itself on the installation during the past year by Mr. N. H. Allen of a Schuyler arc and Heisler incandescent plant at a cost of about $15,000. The motive power is water, but a 90 h. p. engine has been put in the station as a reserve.

The Perkins Lamp and Electrical Supply Company, of Chicago, has been incorporated to manufacture incandescent lamps, supplies and machinery. Capital stock, $250,000. Among its incorporators are J. H. Ward, M. C. Neuberger and W. G. Halm.

Down South.—According to the figures of the Baltimore *Manufacturers' Record*, during the last three years there have been 239 electric light companies formed in the South and only 86 gas companies. In 1888 the electric light companies numbered 122 and the gas companies 27.

The Keystone Construction Company, of Pittsburgh, has just closed contracts in Toronto, Ont., with the Consumers' Gas Company for a central station of 3,000 incandescent lights, and in Fremont, Neb., with the Fremont Gas and Electric Company, for a 750-light station, using the Westinghouse alternating system in both instances.

Edison Plants.—Mr. G. W. Silsby, representing the Edison United Manufacturing Company, has closed contracts for three ferry boats of the Philadelphia & Reading Railroad, each taking 40 lamps of 16 c. p. each; for a central station at South Amboy, with 285 municipal lamps of 20 c. p., and for a central station of 1500 lamps of 16 c. p. at Nyack, N. Y.

Washington Court House, O.—The stockholders of the Washington Electric Light, Heat & Power Company have elected the following directors: D. McLean, M. Sharp, H. B. Maynard, F. L. Nitterhouse and Jerome Penn. Mr. Sharp is the president, and Mr. Penn, a veteran telegrapher, secretary. They hold the same positions in the Washington Gas Light Company.

Abington, Mass.—The annual meeting of the Abington Business Club was held on Jan. 16. The question of connecting the towns of Abington, North Abington, Rockland and Whitman with a system of electric lighting and a street railway came up for discussion. It was found that the cost of a lighting system would be $25,000, while that of a street railway was estimated at $50,000.

Norristown, Pa.—The Norristown Electric Light and Power Company proposes to increase its plant by putting in two No. 10 Edison machines. It is now running two arc machines of a capacity of 70 lights and four incandescent machines of a capacity of 1,000. The officers for the year are: President, J. Shaw; vice-president, I. H. Brendlinger; secretary, B. E. Kerper, and treasurer, W. E. Solly.

The Mather System Popular.—The Mather Electric Company has a number of new contracts, including the following: C. Gotzian & Co., St. Paul, Minn., 300 lights; Chambers, Turner & Layton, Truro, Nova Scotia, 300 lights; Colonnade Hotel, Philadelphia, Pa., 1,000 lights; Evans railway building, Denver, Col., 600 lights; Aberdeen Flats, St. Paul, Minn., 300 lights; *Pioneer Press*, St. Paul, Minn., 2,000 lights.

Train Lighting.—A special dispatch from Chicago of Jan. 17 says: The use of electric light on railroad trains was begun in the Northwest to-night by the Chicago, Milwaukee & St. Paul road. Two trains of nine cars each were started, one train from Chicago for St. Paul and the other in the opposite direction. A novel feature in the sleeping cars is an incandescent burner in every section, permitting the occupant to read a book or paper while lying in bed. The two trains will be run daily.

Sheffield, Ala.—The electric light works department of the Sheffield Land, Iron and Coal Company has just placed an order with the D. A. Tompkins Company, Charlotte, N. C., for a 750-light alternating dynamo and plant, Westinghouse system, and a 75 h. p. Westinghouse engine, 90 h. p. boiler, etc., increasing the capacity to 1,500 lamps of 16 c. p. The plant will use the Schieren leather link belt, which has given the management perfect satisfaction. Mr. A. R. Roe is the electrician and manager.

An Edison Transformer System.—Mr. Barr, of the Montreal Edison local company, on his return to Canada from New York, was interviewed by the *Star* of that city. He reported an interesting chat with Mr. Edison, whom he quotes as saying that the cost of the new Edison central stations is about one-half that of gas plants of equal lighting capacity. Mr. Edison also reiterated his well known views about the alternating systems, but added: "I have now perfected and will have in readiness in two months a transformer which will enable you to take any amount of power from the source of supply, and bring it to the centre of distribution under any pressure desired, and distributed at as low a pressure as you desire. This system will be absolutely safe, for in no case will any high pressure current of necessity go through the public streets, and in no case would it be put within reach of the consumers. There is no chance whatever for the accidental concentration of this energy at any one point in the line of distribution outside of the central station, and I consider that with this transformer I have reached the ideal method of distributing electric current over large areas."

The National Carbon Company.—It will be remembered that the National Carbon Company, of Cleveland, issued last August a very neat and handy "Electric Arc Lighting Directory," and forwarded a copy to each of the three thousand plants of electric arc lighting companies on this continent. It proved of so much interest to their customers that they have tried to add to it a little in the way of a calendar for 1889. In addition to the neat steel plate cut of the Monarch of the Rockies, the noble Elk, at the top, they have made the calendar portion of especial interest and use to arc lighting companies by showing on the face of the calendar in each date space the rising and the setting of the sun and moon for each day during 1889 for the latitude of New York city, 40½°, which would be practically good for the entire country. Usually the hour for lighting begins at sunset or a half hour later, and this time can easily be determined from the calendar. In addition to this for those who prefer the so-called Philadelphia or moonlight schedule, they have had printed on the back of each calendar month the moonlight schedule for that month, which can be easily found by turning up the fly leaf for the month. This calendar will be sent to all users found in the directory, and to any others who may apply.

APPLICATIONS OF POWER.

Green Bay, Wis., is to have an electric railway.

Laredo, Tex.—It is proposed to build an electric road, and Gen. Hurst is said to be interested.

Pittston, Pa.—The new road to be built by the Pittston Electric Railway Company will be six miles long.

President H. M. Whitney is quoted by the Boston newspapers as being very well pleased with the work of his new electric roads.

California.—The *Placer County Republican* states that certain eastern capitalists are talking of erecting an electric light plant at Auburn, and building an electric railroad. W. R. Arthur already has a franchise for a street railroad.

Des Moines, Ia.—Mr. H. O. Woodruff, Sprague agent, reports sales of over 60 h. p. of stationary motors in Des Moines during 1888. The local *Register* is printed by Sprague motor, and under date of Jan. 12 says: "It is good, cheap and satisfactory in every respect."

The Detroit Electrical Works are very busy on street railway work, using the Rae-Fisher system for the filling of their new contracts. They are now building a 7-mile road at Elkhart, Ind., to run 5 cars, and a 3-mile road at Adrian, Mich., to start with 3 cars.

Davenport, Ia.—Last week we published an article on the successful operation of the Sprague electric road at Davenport, Ia. throughout the recent blizzard; and we have now been furnished by the Sprague Company with copies of letters and newspaper clippings on the subject. President Allen and Superintendent Howard of the road write that the results of this severe trial were amazingly gratifying, and their statements are borne out by both the local papers.

Lowell, Mass.—A special dispatch from Lowell, of Jan. 17, says: There has been a rumor around town of the formation of a new railroad company, to be called the Lowell, Lawrence & Haverhill Company, to run cars between these cities by electricity. It is said that New York capitalists are interested, and that permission to run on the tracks of the local street railway companies in Merrimac and Bridge streets will be asked. If this is refused by the Aldermen, it is intended to appeal to the Legislature.

PERSONALS.

Sir John Pender, the English cable magnate, was a candidate at Govan for Parliament in the Conservative interest but lost.

Mr. H. M. Scott, Western Union manager at Salt Lake City died on Jan. 12 of typhoid pneumonia at the age of 35 years.

Mr. T. H. Lyons, of the Thomson-Houston Company at Lynn, Mass., has accepted the position of superintendent of the electric light plant at Pueblo, Mexico.

Mayor Grant, of New York City, announced in his annual message an intention to forward the undergrounding of the wires, and the meetings of the Subway Board will now be held at his office beginning Jan. 21.

Mr. D. A. Tompkins, of Charlotte, N. C., contributes a business-like article to the Baltimore *Manufacturers' Record* on "Electric Lighting," in which he discusses the various methods, and gives figures of outlay and income.

Mr. F. J. Masten, in the *Practical Mechanic*, gives young mechanics a good word of advice as to the necessity of studying up electrical subjects, beginning with elementary text books, and then mastering some special branch, such as lighting and power.

Mr. C. W. Russell, representing the Russell Manufacturing Company, of Providence, R. I., has been a visitor in New York, looking into the numerous opportunities that present themselves for the introduction of his mast arm, which is already so extensively in use.

Dr. J. B. de Lery is the general manager of the Wenstrom Southern Electric Manufacturing Company of Baltimore, and has had the honor of having his portrait printed in the local papers. The company have taken a large factory on Locust Point, and Dr. de Lery is to "push things."

Lieut. Bradley A. Fiske has devised an electric hoist for shot on board men-of-war. One of the machines has been built by the Sprague Company and will be put on the "Boston." It is said to be a great improvement on old methods of handling ammunition with an ordinary shell whip.

Mr. Henry V. G. Wilkin, for more than 25 years chief telegraph operator in the Erie Railroad Company's office at Goshen, died in St. Luke's Hospital, in this city, on Sunday, Jan. 13, of cancer of the stomach, at the age of 50 years. He was widely known, and held in high esteem along the line of the Erie road.

M. Abdank Abakanowicz.—This well known electrician who represents officially the electrical part of the French exposition, is again in this country, to make final arrangements in connection with many of the exhibits. The demand for space has been so great that some of the U. S. Government exhibits will have to be left out.

Dr. Durand Woodman, formerly chemist of the United States Electric Lighting Company, is now fully established as an analytical and electro-technical expert, with offices in Broad street, Newark, and in New York. His expert work includes not only electrical matters, but fuels, lubricants, etc. He has lately been engaged with some experimental work on alloys.

Mr. Villiers, the English newspaper artist and war correspondent, now lecturing in this country, says that "he sees beauty in the clustering telegraph wires overhead, stretching from pole to pole, which break the crudeness of the lines, and are, besides, so characteristic of the busy commerce of a great, industrious people. And such great pine poles!" he exclaims, "that are seen nowhere else in the world."

Mr. A. R. Foote, of Cincinnati, Ohio, has printed and published, for private circulation, a neat and pithy little pamphlet on "Electric Light and Power." It is in two parts: 1. The Electric Service of a City, and 2. Should a City own an Electric Central Station? The first edition is practically a proof, as Mr. Foote intends to add an appendix comprising much valuable information. The pamphlet discusses its subject with much ability and breadth of treatment.

Prof. A. G. Bell has lectured to the students in electrical engineering at Cornell University on some of the latest developments of telephony, detailing his own recent work in the field. An interesting portion of the able address dealt with the use of the induction balance in surgery. Prof. Bell exhibited the apparatus used in probing for the bullet in President Garfield's body; and showed the first bullet that had been extracted by means of the balance. It had been carried by the man in his body for 20 years.

MISCELLANEOUS NOTES.

The Sheffield Velocipede Car Company, at Three Rivers, Mich., have lost their wood working shop by fire. The loss is placed at $25,000, insured.

East Taunton, Mass., will, it is said, have an electrical supply factory established by Boston capital in the works formerly occupied by the Old Colony Iron Company.

Another Subway Explosion has occurred in this city, the cover at the manhole at Nassau and Pine streets being blown off last Saturday. The pavement was broken up but no one was hurt.

The Cobb Vulcanite Wire-Works.—The Wilmington, Del., *Every Evening* has an appreciative article on the illustrated description recently printed in these columns of the Cobb vulcanite wire-works at Wilmington.

The G. T. Woods Manufacturing Company, of Newport, Ky., has been incorporated with a capital stock of $500,000, by G. T. Woods, L. Robertson, E. Thiesing and J. Oster, Jr. It will manufacture electrical and mechanical appliances under Mr. Woods' patents.

The fall of a pole startled the spectators in Prince street, this city, last Saturday, when a lineman fell with it, breaking his arm. It appears that the pole was rotten, and had been held up

simply by the wires until they were cut to be transferred to new poles.

The Wenstrom Dynamo is being introduced by the Wenstrom Southern Electric Manufacturing Company, of Baltimore. The officers are: Robert Rennert, president; Dr. J. B. de Lery, general manager; J. S. Crowther, secretary and treasurer. Mr. B. Blum was one of the incorporators. Mr. W. F. D. Crane is the electrician.

Academie des Sciences.—The prize which the Académie des Sciences has offered without result for several years in succession for some important advance in the theory of the electrical transmission of power has this year been withdrawn on the suggestion of MM. Deprez, Bertrand, Mascart, Becquerel, and Maurice Levy, who formed the committee of award.

Our New Navy.—The New York *Commercial Advertiser* has published as a supplement a very able and interesting illustrated account of all the ships in our new navy, entering into all the details and not forgetting the electrical equipment. The article is a timely piece of enterprise and gives the public an excellent idea of the manner in which money is being spent for some very necessary work.

"A Phonographic Row" is the title that the daily papers in this city have been giving to certain column-long stories of alleged troubles between Mr. Edison and Mr. Tomlinson, due to the withholding, it is asserted, of a certain part of the money paid over for the phonograph patents. The stories purport to be very circumstantial, but the appearance is that they who know anything of the matter decline to talk.

Wires in St. Louis.—A special dispatch from St. Louis of Jan. 18 says: The special committee appointed by the Municipal Assembly of St. Louis to investigate the various systems of carrying telegraph, telephone and electric wires reported to-night in favor of the underground conduit system. Evidence was heard from Chicago, New York and St. Paul. The committee recommended the adoption of the Dorsett system and the passage of the bill now before the Assembly granting a franchise for a subway. A bill will also be introduced to abolish aerial wires and poles. The Dorsett bill is expected to become a law next Tuesday.

Ozokerite from Utah.—A carload of ozokerite, or natural mineral wax has just arrived from Utah oil fields, 114 miles from Salt Lake City. The natural paraffine was discovered two years ago by J. Wallace of this city, when explorations of oil fields in Colorado and Utah were made. It has now been found in quantities, and is being mined for use in this country. About 500 tons a year have been used in the United States, and it has come from Moldavia and Galicia, Austria. It is used for adulteration of beeswax, the manufacture of candles and wax paper, and recently as a water-proof insulator for electric wires. The specimens from Utah of ozokerite melt at 160° to 190°, while the highest grade paraffine melts at 142°. The mineral wax varies from black to a yellowish tinge. It is found in veins from 5 to 10 inches through. Specimens of the paraffine are on exhibition at Room 155 in the Stewart Building.

The U. S. Torpedo Station.—The Secretary of the Navy has issued a general order consolidating the institution on Coasters', Harbor Island, in the harbor of Newport, R. I., known as the "Naval War College," with the torpedo station on Goat Island, in said harbor, which station, as consolidated, will hereafter be known as the "Naval Torpedo Station and War College," and is placed under the command of the officer in charge of the torpedo station. The library and movable property belonging to the Naval War College will be transferred to the Naval Torpedo Station and War College. The custody and control of the large building and surrounding structures, with the adjacent grounds on Coasters' Harbor Island, heretofore occupied for the purposes of the Naval War College, will be turned over to the Bureau of Equipment and Recruiting for the use of the naval training station on that island. The establishment of a more thorough system of instruction to be pursued at the Naval Torpedo Station and War College being now under consideration, suitable orders relating thereto will, after such system shall have been adopted, be issued by the department.

BUSINESS NOTICES.

The Mason Regulator.—Messrs. Small & Fisher, of Wood. stock, N. B., write to the Mason Regulator Company, of Boston: "We have put the reducing valve on and it works first rate. Could not be better."

The Russell Manufacturing Company, of Providence, R. I., have sold 142 of their mast arms, making a total of about 250 for the Waterhouse lighting service in Pittsburgh. The 142 range from 23 to 51 feet in length, and will probably be the longest mast arms in use.

Patterson, Jordan & Gottfried, 146-150 Centre street, carry a complete stock of brass and iron machine and wood screws, cap and set screws, all kinds of bolts, taps, files, twist drills, brass and rubber tubing, brush copper, rod and sheet copper, brass rod, sheet German silver, sheet brass, machinery, tools, hardware, etc., and electrical supplies.

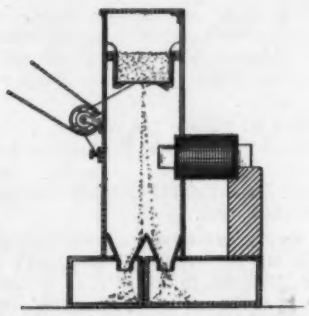
The Eclipse Wind Engine Company, of Beloit, Wis., report that the rapid increase in the establishment of electric light and power stations throughout the country has brought to them such a large number of orders for friction clutch pulleys and cut-off couplings that they find it necessary to run their clutch works day and night. They have already ordered machinery and taken steps to again largely increase their facilities for turning out this device, which they consider so indispensable to the successful working of large electric plants. Their advertisement will be found on page xiv of this issue.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED JANUARY 15, 1889.

396,086. Synchronizing Device for Dynamo-Electric Machines; Carl Hoffmann, Berlin, Germany, Assignor to Seimens & Halske, of same place. Application filed Dec. 2, 1887. For description see THE ELECTRICAL WORLD, July 23, 1887.

396,121. Thermo-Magnetic Motor; Nikola Tesla, Smiljan, Lika, Austria-Hungary. Application filed March 30, 1886. In this



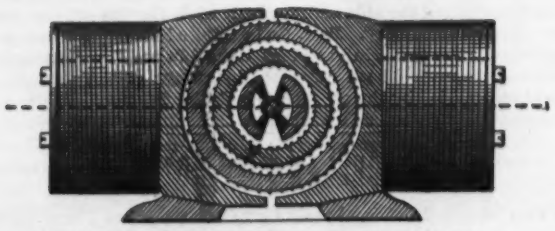
396,356. MAGNETIC SEPARATOR.

invention mechanical power is obtained by a reciprocating action resulting from the joint operations of heat, magnetism and a spring or weight. The body magnetized by induction or otherwise, is subjected to the action of heat until the magnetism is sufficiently neutralized to allow a weight or spring to give motion to the body and lessen the action of the heat so that the magnetism may be sufficiently restored to move the body in the opposite direction, and again subject the same to the demagnetizing influence of the heat. See illustration.

396,124. Suspended Switch for Electric Railways; C. H. Wells, Kansas City, Mo. Application filed April 25, 1888. An overhead system for electric railways provided with traveling trolleys and depending motor-connections, and consisting of the main conductors carrying currents of opposite polarity, two pairs of branch conductors, the outer members of which form continuations of the main conductors, and the inner members being connected to the main conductors by an automatic switch provided with flexibly-supported end sections normally in contact with the main conductors, but adapted to be swung aside to permit the passage of trolleys traveling in either direction.

396,149. Unipolar Dynamo-Electric Machinery; R. Eickemeyer, Yonkers, N. Y. Application filed May 22, 1886. This relates to machines having armatures provided with radial conductors, in connection with which there are arranged coincident magnetic pole faces which are rectangular to the axis of the armature, and afford a circular magnetic field within and through which the radial conductors travel.

396,176. Electric Coupling for Hose Pipes; D. J. Simpson, Pittsburgh, Assignor of one-half to George C. Corken and Hawdon Marshall, of Allegheny County, Pa. Application filed April 16, 1888. The coupling is provided with ring seats and an interposed non-conducting gasket. A contact electrode is carried by one section of the coupling and connected with the line through the gasket. There is an opposing contact secured to the other section of the



396,355. DYNAMO-ELECTRIC MACHINERY.

coupling in position to engage the first mentioned contact when the gasket is clamped between its seats. The contacts in connecting the wires are insulated from the metallic coupling.

396,195. Armature for Dynamo-Electric Machines; Leo Daft, Plainfield, N. J. Application filed Nov. 12, 1885. An armature consisting of a cylindrical core, rings connected to the core and having outwardly-extending arms, and spiders connected to said arms.

396,196. Insulator Support for Electric Conductors; Leo Daft, Plainfield, N. J. Application filed Dec. 29, 1886. The combination of the support, pendent bonnet, bracket supporting a conductor and provided with a cross-head having openings, bolts passing through said openings into the bonnet, an insulating material between the heads of the bolts and the cross-head and between the cross-head and the bonnet.

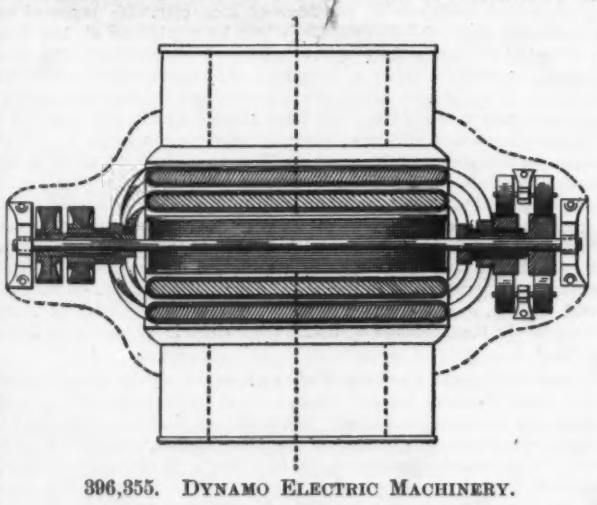
396,199. Electric Appliance for Discharging Guns; Bradley A. Fiske, United States Navy. Application filed May 3, 1888. The principle of this invention is as follows: To cause an electric circuit automatically to be closed or opened when a body oscillating on a centre in a vertical plane shall make with the horizontal plane a certain predetermined angle, and to effect this closing or opening of the circuit by the action of gravity upon a body free to move in response thereto. By the application of this principle a gun upon a rolling ship may be set to fire whenever the rolling of the ship brings the gun to the level or angle required. The circuit is closed by a mobile liquid acted upon by gravity. See illustration.

396,207. Electric Signaling Apparatus; William Henion, Ritchey, Illinois. Application filed July 25, 1888. The signals are mounted upon a rotating shaft which is controlled by an electro-magnet. The rotation of the shaft successively brings the different signals to view.

396,212. Electrical Body Wear; John V. Long, Jersey City, N. J. Application filed Feb. 28, 1888. This invention consists mainly in an electric circuit controller constructed so as to be operated by the swelling of the muscles of the human body. The circuit is is closed when the tension of the muscles reaches a certain predetermined point. The device is in the form of a bracelet or collar in two parts, one being movable with respect to the other, a certain amount of movement causing contact between the circuit terminals, which then rings an alarm.

396,213. Secondary Battery; Orazio Lugo, New York, N. Y. Application filed June 20, 1888. For description see page this issue.

396,241. Headlight; J. F. Shawhan, Dayton, Ohio, Assignor of one-half to James W. Carpenter, of same place. Application filed March 23, 1888. This is an invention whereby a headlight of



396,355. DYNAMO ELECTRIC MACHINERY.

a locomotive may be changed at will into an electric or oil lamp, both mechanisms being included within the same casing.

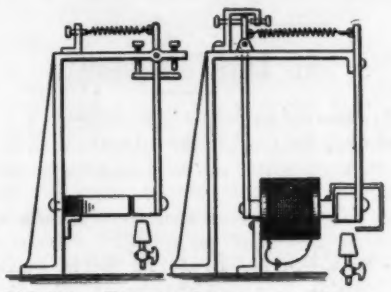
396,269. Electro-Dynamic Machine; C. Coerper, Cologne, Prussia, Assignor to the Helios Actien-Gesellschaft fuer Elektrisches Licht und Telegraphenbau, of Ehrenfeld, Germany. Application filed Feb. 5, 1888. The combination, in a dynamo-electric machine, for the transmission of power, of a shaft or axle, an armature and field magnets on said shaft or axle, one of the elements of the dynamo machine, either the armature or field magnets being loosely mounted on the shaft or axle, and a brake or other check mechanism applied to the loosely mounted element and capable of locking the same in a position of rest.

396,270. Process of Electric Welding; Charles L. Coffin, Detroit, Mich. Application filed June 19, 1888. The process of electric welding, consisting in forming a voltaic arc between two conductors extending beyond the points thereof, feeding a strip of metal into the arc between the conductors, and submitting the joints to be welded, and the strip of metal simultaneously to the action of the arc.

(1) 396,310. (2) 396,311. (3) 396,312. (4) 396,313. (5) 396,314. 1. Traveler for Electric Railways; 2. Hooked Suspender for Electric Railway Conductors; 3. Suspension Device for Electric Railway Conductors; 4. Adjustable Crossing and Switch for Overhead Conductors; 5. Commutator Brush Carrier for Electric Motors; Charles J. Van Depoele, Chicago, Ill. Applications filed June 5, 1888; Nov. 7, 1888; Nov. 7, 1888; Nov. 14, 1888, and Feb. 8, 1887, respectively. 1. A traveler for electric railways comprising a metallic contact wheel or wheels arranged to travel upon the conductor, a metallic frame inclosing the wheel and contact devices electrically connecting the exterior of the wheel and the frame. 2. A suspending device for electric conductors, consisting of a metallic hook having a downwardly-extending part adapted for attachment to a conductor to be supported and a laterally extending supporting wire or cable connected to the hook. 3. A device for suspending electric conductors, consisting of an arch secured to transverse support or supports, and an ear or bail connected to the conductor to be suspended, and adjustably secured to the arch. 4. A crossing or switch for suspended electric conductors comprising two or more adjustably connected members adapted for attachment to the respective conductors. 5. Two sets of brushes are mounted in a frame rotatable on the shaft and by the movement of a single lever either set of brushes may be thrown on or off the commutator to change the direction of rotation of the armature.

396,329. Galvanic Battery; P. R. De F. D'Humy, Clapham Rise, England. Application filed Aug. 15, 1888. This is an arrangement of a cistern divided into compartments and containing the liquids for charging the battery cells, arranged in a frame with the cells below the same and connecting by means of suitable ducts therewith. Proper levers and valves are provided for the charging and discharging operations.

396,334. Overhead Insulator; S. H. Gilson, Salt Lake City, Utah Territory. Application filed Sept. 28, 1888. This is an insula-



396,121. THERMO-MAGNETIC MOTOR.

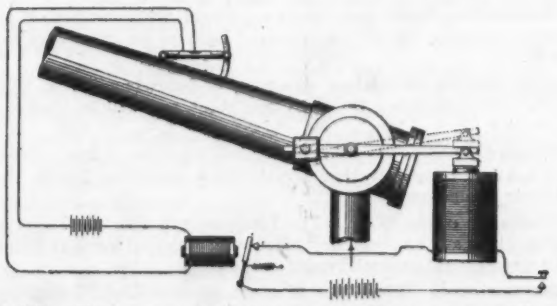
tor of a special kind of composition, not described in the patent, but bearing the name "gilsonite."

396,342. Galvanic Battery; B. Scheithauer, Halle-on-the-Saalle, Germany. Application filed Dec. 5, 1887. The improvement relates principaly to the prevention of polarization by causing the hydrogen collecting on the carbon plates to be removed by means of chlorine gas, the latter combining with hydrogen to form the hydro-chloric acid, which is also utilized for the further production of chlorine.

396,365. Railway Signal; Wm. C. Paul and Oscar D. Kleinsteuber, Milwaukee, Wis., Assignors of one-third to Thomas K. Ewing, of same place. Application filed July 21, 1887. The combination, with the electro-magnet and its pivoted armature having a double catch head on its free end of two oppositely faced cam-wheels, and clock-work gearing for driving them, a wrist wheel carried by the shaft of one of the cam-wheels and levers linked to said wrist wheel and to the signals.

396,355. Dynamo-Electric Machinery; Isaac T. Dyer, Chicago, Illinois, Assignor of five-eighths to Peter Fish and Gustave Mourath, of same place, and George C. Ewing, Jr., of Enfield, Mass. Application filed Feb. 7, 1888. The invention consists in a dynamo-electric machine having two sets of magnets and movable armatures one within the other. See illustration.

396,356. Magnetic Separator; Thomas A. Edison, Llewellyn Park, N. J., Assignor to the Edison Ore Milling Company (Limited), of New York, N. Y. Application filed March 29, 1888. The finely divided ore and pulp is dropped through a tower or elongated chamber, and on its passage through the same it passes the field of force of a magnet which deflects the magnetizable portions from its path of movement and causes the same to fall in a



396,199. ELECTRIC APPLIANCE FOR DISCHARGING GUNS

compartment by itself at the bottom of the chamber, while the remaining portions continue straight on their course, and are deposited in another compartment. See illustration.

396,367. 396,368. 396,369. Secondary Battery; Isaiah L. Roberts, Brooklyn, N. Y., Assignor to the Roberts-Brevoort Electric Company (Ltd.), of New York. Applications filed Oct. 11, 1888; May 1, 1888, and May 1, 1888. These patents relate to a method of retaining the active material within the supporting plate. The method consists generally in coating the outside of the plate, after the active material has been applied thereto, with a paste formed of starch and a weak solution of sulphuric acid. It is alleged that chemical activity takes place through the paste with almost the same freedom as through the liquid generally employed, the paste in fact acting like solid water or as a permanent or fixed electrolyte.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co. Ltd., Potter Building, N. Y.